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DEVELOPMENT REPORT FOR THE 10 KW SOUND ATTENUATION PROGRAM (PRE--ETC(U)
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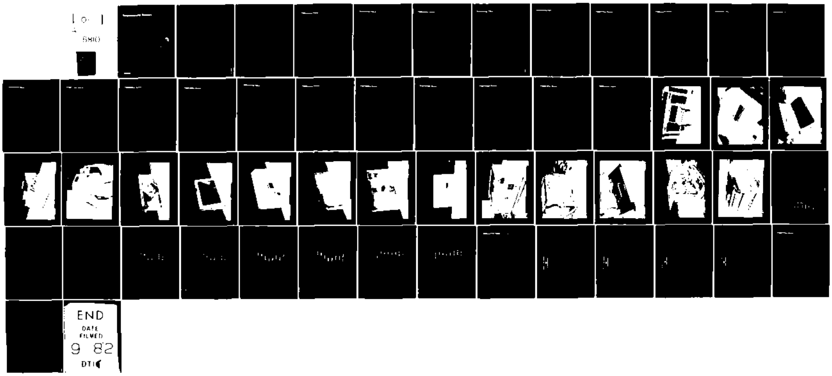

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Engineering Report

AD A118810

DEVELOPMENT REPORT FOR THE 10 KW SOUND ATTENUATION
PROGRAM CONTRACT DAAK 70-77-C-0032
(PREPRODUCTION "F" KIT)

REPORT ERR 0195   ISSUED 2 December 1981

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REPORT DOCUMENTATION PAGE

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Gas Turbine Engine Driven
Acoustic Housing
Catagory F Requirements MIL-STD-1474

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This final report covers the program undertaken by Turbomach Division of Solar Turbines Incorporated to develop an acoustic enclosure for the 10 KW 60 Hz GTED Generator Set. The enclosure was designed to meet the performance requirements of category F of MIL-STD-1474. Tests were conducted to determine any detrimental effects of running the gas turbine engine inside of a closed environment. Tests were also conducted to determine the acoustical characteristics of the enclosed package and a comparison done with the standard 10KW Cont'd

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20. Abstract

60 Hz generator set to determine the attenuation provided by the acoustic enclosure.

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LIST OF FIGURES

1.0 INTRODUCTION

This report covers the development, test and evaluation of a preproduction "F" kit acoustic housing per CLIN 0010 of contract DAAK70-77-C-0032. The objective of this task was to optimize the concept of a "bolt on" type of acoustic kit for the 10 KW, 60 Hz Gas Turbine Engine Driven (GTED) Generator Set.

The noise level limit for this kit was 65 dB(A) at a distance of 6 meters from the center of the set. The following octave band limits for this acoustic kit were specified per the 1 March 1973 version of MIL-STD-1474, Table 2, Category F:

Octave Band Center Frequency (Hz)	Maximum Sound Pressure Level dB (re 0.002 microbar)
63	86
125	77
250	69
500	62
1000	60
2000	59
4000	59
8000	61

Application of the sound attenuation kit to the standard 10KW, 60Hz set was to be accomplished while minimizing weight addition and without obstructing daily maintenance functions.

While the requirements specified were maximum limits, it should be recognized that due to the conceptual nature of this program, certain properties of the "Silent Power Package" would exceed the prescribed limits in the interest of obtaining the best overall silent package configuration.

Publication of this report does not constitute U.S. Army (MERADCOM) approval of the findings or conclusions presented herein and is published only for the exchange of information.

2.0 PREVIOUS DESIGN STUDIES

The Preproduction "F" Kit Acoustic Housing under investigation is the result of several phases of a sound attenuation program undertaken by Solar Turbines Incorporated for the U.S. Army. The "E" and "F" Kits referenced in this report are acoustic housings designed to meet catagory E and catagory F requirements of MIL-STD-1474. The "E" Kit design emphasized attenuation of individual noise sources while the "F" Kit was designed to enclose the entire generator set.

The initial phase of the program involved the establishment of baseline noise level and set performance parameters for the 10KW GTED 60 Hz Generator Set. Emphasis was placed in the determination of specific sources of sound generation, their avenues of transmission and the effect of temperature levels on set performance.

The second phase of the Silent Power Program involved the analysis of the above baseline data to determine the means and techniques to obtain the optimum sound level attenuation of the 10 KW GTED 60 Hz Set. This baseline data was then compared to the baseline data obtained for the 60 Hz Turboalternator set and evaluated in light of the attenuation treatments applied to the Turboalternator Set under contract DAAK02-71-C-0311. The results of that evaluation were used to determine modifications required on the 60 Hz Set to comply with the requirements of categories C through F of MIL-STD-1474.

Phase three of the program consisted of the fabrication, test and evaluation of a sound attenuation treatment for the 10 KW GTED 60 Hz Set. These results were used to propose a means by which category F requirements, 65 db(A) at 6 meters, could be met on the 60 Hz Set.

The next phase of the program involved the addition of various devices on the engine components to fulfill the steady state noise limits as defined by category F of MIL-STD-1474A.

All subsequent phases of this program have been in the interest of "fine tuning" the "E" and "F" kits for the 10 KW GTED 60 Hz set to provide maximum noise attenuation while minimizing weight addition and adverse effects on set operating parameters. This included an investigation into the additional acoustical treatment necessary to achieve 100 meter aural non-detectability as defined in MIL-STD-1474. Evaluations were also made on the producibility of both "E" and "F" kits.

Detailed accounts of the previous work done on the Silent Power Program under contracts DAAK02-71-C-0311 and DAAK70-77-C-0032 can be found in the following Solar reports:

ER 2447	10 KW Silent Power Program, Interim Report
ERR 2959-1 through 12	Monthly Progress Report - 10KW Sound Attenuation Program
ERR 0035	Development Test Report for the 10 KW Sound Attenuation Program

3.0 ACOUSTIC ENCLOSURE

3.1 Discussion

The acoustic enclosure under investigation is a "bolt on" type acoustic kit, the design of which was based on the prototype "F" kit previously developed under CLIN 0004 of contract DAAK70-77-C-0032. The basic design concept of the kit consisted of acoustic panels which could be applied to the standard 10 KW GTED 60 Hz Generator Set while retaining the existing inlet and exhaust ducting.

The acoustic housing consisted of five separate panels; four side panels and the top panel. For the purposes of this report, the four side panels shall be indentified as follows: the panel closest to the operators station shall be the forward panel, the panel opposite the forward panel (at the exhaust end of the unit) shall be the aft panel and the side panels shall be designated right and left side panels as seen from the operator's station.

The panels overlapped by 1 3/4 inches and were sealed with silicone rubber to prevent sound leakage from between panel joints. Disregarding the modifications made to the standard 10 KW set, there were fourteen (14) bolts that held the sound attenuation kit to the basic generator set, four per each side panel and six on the forward panel. A total of ten (10) bolts secured the forward, aft and top panels to the side panels of the housing. Complete disassembly of the acoustic housing could therefore be accomplished with the removal of twenty four (24) bolts.

Access to the various components on the set requiring adjustment or servicing was provided through the use of hinged access panels. A total of four access panels, or doors, were incorporated into the package; two on the top panel and one on each of the two side panels. Engine components requiring periodic service and their avenues of access are shown in Table 1.

The original design housed the battery on the right side of the unit, externally from the engine/generator set (See Figures 1, 2 and 4). This configuration made battery maintenance very awkward and was abandoned. It was noted that battery heating from exposure to the engine/generator was not as severe as originally expected and that ambient air induced over the battery through slots in the side panel was sufficient for battery cooling purposes. The top of the battery box was therefore removed and the opening in the right side access panel covered to obtain better acoustical integrity for the package. With this change, periodic battery maintenance remained accessable through the right side access panel (See Figure 3).

Load connections in the distribution box were made through an access door on the left side panel. The load cables were routed through the front of the distribution box and through an opening at the bottom, left side of the forward acoustic panel (See Figure 14).

3.2 Panel Design

The panels were to be constructed from solid aluminum sheet metal on all exterior surfaces and acoustic fiberglass or mineral wool bill overlayed with a synthetic film and encapsulated with perforated aluminum on the interior surfaces.

Per design, the acoustic panels on the kit were constructed from .125 thick 6061-T4 aluminim plate with .032 thick 3003-H14 perforated aluminum sheet on all suitable interior surfaces. The panels were acoustically insulated with Johns - Manville 1.50 thick spin-glas blanket insulation, type 5G-24, and a .001 to .002 Kapton Polymide sheet overlay to prevent absorption of fuel and oil.

All panel surfaces that overlapped with other panels were lined with silicone rubber sponge to insure a good acoustical seal.

All access panels were of similar construction as the housing panels. Each access panel was acoustically sealed with silicone rubber sponge and latched with Southco fasteners, part number 48-10-402-10. (See Figure 5)

The complete preproduction "F" kit is shown in Figure 4 and the individual acoustic housing panels are shown in Figures 6-11. The additional weight imposed by the "F" kit acoustic panels is summarized in Table 2.

Table 1. Engine Component Accessability

COMPONENT	ACCESS PATH
Battery	Right Side Access Door
Cup Motor	Top Aft Access Door
Day Tank	Right Side Access Door
Diagnostic Test Plug	Forward Panel
Electric Fuel Pump	Right Side Access Door/Forward Panel
Fuel Control	Top Forward Access Door
Fuel Filter	Right Side Access Door
Fuel Solenoid Valve	Top Aft Access Door
Ground Stud	Forward Panel
Oil Filler Cap/Dip Stick	Top Aft Access Door
Oil Filter	Top Aft Access Door
Remote Control Plug	Forward Panel
Storage Box	Forward Panel

Table 2. "F" Kit Acoustic Housing Component Weights

COMPONENT	QTY.	WEIGHT (LBS)
Forward Panel (Operators Position)	1	20.0
Aft Panel (Exhaust End)	1	18.6
Right Side Panel (Battery Side)	1	31.6
Left Side Panel (Load Lead Connection)	1	30.5
Top Panel	1	56.8
Eductor Flange	1	1.4
Lifting Handles and Hardware	4	2.4
Battery Box		
Side Plates and Spreader Bar		12.0
Cover	1	.4
Miscellaneous Hardware (Nuts, Bolts, etc.)		3.5
Adaptation Hardware (Base Plates)	2	3.0
TOTAL HOUSING WEIGHT		180.2
STANDARD 10 KW GTED GEN. SET WEIGHT		460.0
TOTAL SILENT POWER PACKAGE WEIGHT		640.2

3.3 Air Flow Considerations

A critical design factor involved when enclosing a gas .rbine engine is the air flow required for combustion and for cooling of various components. Allowances must be made to maintain component temperatures below maximum operating limits.

Oil cooling on the standard generator set is achieved by use of a fan that directly cools the gearbox assembly. This fan is located between the gearbox and the generator and requires a cool air supply to effectively cool the gearbox oil.

Ambient air ducted through the enclosure into the compresor inlet was to remain completely isolated from the higher temperature air inside of the acoustic enclosure. This was done to prevent loss of engine performance due to high engine compressor inlet air temperatures.

Cooling air for the engine and its various components was drawn through several small openings and slots located at different positions on the enclosure. The left and right side panels each had one small hooded duct built into it solely for the purpose of allowing air flow into the enclosure. Additional air flow was allowed into the enclosure through the drain ports at the bottom of the right side panel. A one half (1/2) inch gap was made along the entire length of the bottom of the aft panel to allow cooling air to flow over the exhaust collector box. A separate duct on the forward panel was utilized to allow ambient air in for generator cooling (see Figure 14).

As previously noted in 3.1 for the original concept of the preproduction "F" kit, the battery was to be completly isolated from the generator set and left exposed to ambient air for cooling purposes. Due to the location of the battery, total isolation from the engine was not feasible. The partial isolation concept, shown in Figures 1 and 2, yielded poor seviceability, hence the external battery box was eliminated. The opening in the right side panel was closed off except for a small vent at the bottom to allow air to flow over the battery for cooling. The modified right side panel configuration is shown in Figure 3.

A baffle which separated the combustor housing from the exhaust collector was incorporated on the top panel for a two fold purpose. The baffle provided for air flow over a greater surface area of the exhaust collector and prevented heat from the exhaust collector from radiating back to vital engine components (see Figure 10).

4.0 MECHANICAL ADAPTATION OF ENGINE/GENERATOR SET

The basic concept of the sound attenuation kit consisted of an acoustical treatment that could be applied directly to the standard 10 KW 60 Hz Generator Set. In order to achieve this purpose and still maintain good acoustical characteristics, minor modifications were made to the generator set frame.

The forward acoustical panel was hinged to a bracket which was attached to the set frame with six (6) .250-28 UNF screws. Mounting of this panel required drilling six holes through the tubular part of the frame adjacent to the operators station.

The remainder of the kit was secured to the set through four attachment points on each side of the frame. The right and left side acoustical panels were each attached to the unit with four (4). 375-24 UNF screws. This required drilling four holes through the tubular framework on each side of the generator set (see Figure 12).

In order to support the installation of the side panels, a base plate was attached to the base skid at each side of the unit (see Figure 12). The acoustical properties of the kit were enhanced by using a silicone rubber sealing material at this panel joint.

The acoustical inlet duct in the top panel mated directly with the set inlet air filtration assembly. This eliminated the need for the air inlet hood assembly, part number 74-8350.

The lifting handles extended through the right and left side panels and attached to each corner of the frame with two .312-24 UNF screws (see Figures 5 and 13).

The distribution box cover panel was removed from the set to allow access to the distribution box through the access door on the left side acoustic panel (see Figure 12).

5.0 PACKAGE ASSEMBLY/DISASSEMBLY

Providing the generator set modifications in the preceeding section had been accomplished, installation of the Preproduction "F" Kit enclosure was most readily accomplished when the following assembly steps were taken.

1. The side panels were the first to be installed on the unit. It was important that the side panels be aligned properly to insure that the remaining panels would be properly positioned. Shim stock was used at each of the four attachment points on the side panels to establish their proper positioning and insure that they were parallel (see Figure 13).

2. The front panel was then installed and checked for proper fit. At this point, the side panels were shifted forward or aft to allow the forward panel to seal properly with the control panel (see Figure 14).

3. The aft panel was installed next and positioned such that the top of the panel was in alignment with the tops of the right and left side panels (see Figure 15).

4. The top panel was the last to be mated with the enclosure assembly. If all other panels are properly located, a good seal will occur between the engine air inlet and the top panel acoustic air inlet.

The Assembled Silent Power Package is shown in Figure 16. Removal of the acoustic enclosure was accomplished by reversing the above installation procedure.

6.0 PERFORMANCE TEST AND EVALUATION OF THE SOUND ATTENUATION PACKAGE

The test effort on the preproduction "F" kit acoustic package was divided into two phases. The first phase of testing concentrated on the effects of operating the gas turbine generator in an enclosed environment. Of primary importance during this phase of testing was the determination of heat concentration points within the package. The second phase of testing was devoted to establishing the acoustical signature of the generator set/acoustic package combination.

6.1 Temperature Survey

The temperature survey was conducted to establish whether or not any of the system components would be adversely affected by the increased temperatures encountered while operating in a closed environment. The Generator Set was instrumented to monitor temperatures at 22 key engine component and package locations. The components and locations monitored are listed in Table 3.

Problems were encountered initially with a high incidence of low oil pressure shutdowns. This was a characteristic of this particular set (+3000 hrs) when exposed to high operating temperatures and long term run times. This is not a problem area in new sets and it is recommended that the customer monitor oil pressure during operation of this set to insure oil pressures of at least 7 psig.

During the test effort, a high failure rate was encountered with the power transistor in the cup motor drive circuit. The power transistor was relocated to the cooler environment of the control console as a corrective action. Further testing proved this configuration also to be unsatisfactory. The final solution to the problem involved connecting two (2) power transistors in parallel to reduce the current load on each transistor.

Originally, oil cooling for the 10 KW 60 Hz Generator Set had been accomplished by direct cooling of the gearbox assembly (see Section 3.3). Due to the high temperature environment induced by the acoustic enclosure, this method was unsatisfactory when operating at full load. An external oil cooler was added to the oil system and mounted to the outside of the right side acoustic panel (see Figure 16). The radiative cooling provided by this configuration was sufficient for continuous operation of the set at full load.

Table 3. Temperature Survey Instrumentation

POSITION #	LOCATION	T/C TYPE
1	Oil Sump	J
2	Fuel	J
3	Air Inlet Filter	J
4	Air Inlet Filter	J
5	Air Inlet Filter	J
6	Generator air Inlet	J
7	Gearbox Cooling Vent	J
8	Gearbox Cooling Vent	J
9	Exhaust Collector	J
10	Exhaust Collector	J
11	Exhaust Collector	J
12	Start Contactor Box	J
13	Cup Motor Heat Shield	J
14	Cup Motor Case	J
15	Fuel Solenoid Valve	J
16	Combustor Housing Ambient	J
17	Compressor Air Inlet	J
18	Generator Exhaust Tube	J
19	Exhaust Gas Temperature (EGT)	K
20	Exhaust Gas Temperature (EGT)	K
21	Power Transistor	J
22	Ambient	J

T/C TYPE: J - Iron/Constantan
K - Chromel/Alumel

Engine overtemperature shutdowns were encountered during the early stages of the temperature survey while operating the set at full load. This problem was traced to an improper seal between the mating surfaces of the set air inlet filter and the inlet duct on the top panel of the acoustic enclosure. The improper seal allowed high temperature air from inside the enclosure to leak into the engine inlet duct. Temperature increases of up to 70°F were observed between ambient temperatures and compressor inlet temperatures while this condition existed. Several modifications were made to the top panel which enhanced the fit between the acoustical inlet duct and the inertial air filter. These modifications reduced the temperature differential between ambient and compressor inlet to approximately 30°F, allowing set operation at full load in ambient temperatures up to approximately 90°F.

Another factor involved in the occurence of overtemperature shutdowns was the recirculation of exhaust gasses into the air inlet duct. This problem was encountered only while operating in the near vicinity of the Turbomach test facility. This recirculation was attributed to variable winds and eddy currents in the area and was alleviated by attaching a fourteen (14) inch exhaust extension to the enclosure. The exhaust extension was not required while operating at other locations, however sound level measurements were taken to determine its effect on the acoustical performance of the package.

Results of the temperature survey at no load and full load conditions are shown graphically in Figures 17 and 18.

The skin temperature of the acoustic enclosure was not instrumented during the temperature survey but was, however, affected by its high temperature environment. The perforated metal on the aft panel was warped due to its close proximity with the exhaust collector. Several welds were broken at the top of the aft panel due to deformation of the .125 Al plate. This area will require reinforcement if additional enclosures are made.

6.2 Acoustical Evaluation

The sound attenuation properties of the silent power package were tested at the Turbomach facility in San Diego, CA. Sound level measurements were taken at the operators station and at multiple positions six (6) and seven (7) meters from the set. The sound pressure levels at these positions were measured at octave bands from 63 Hz to 8000 Hz and at the "A" weighted and flat responses as shown in Figure 19.

A General Radio model 1558 BP Precision Sound Level Meter/Octave Analyzer System was used to acquire data. The microphone was positioned five feet eight inches (5'8") above ground level at an angle of approximately 45° from the sound source. There was no prevailing wind at the test site during the acoustical tests.

The results from the 6 meter acoustic tests at no load and 10 KW load are shown in Figures 20 and 21. The results from the 7 meter acoustic tests at no load and 10 KW load are shown in Figure 22 and 23. The test data sheets documenting the sound pressure level measurements taken at Turbomach are contained in Appendix I. The baseline acoustic data for the 10 KW Generator Set, taken from previous acoustical tests, is shown in Figures 24 and 25. Preliminary sound pressure level measurements taken on the preproduction "F" kit are included in Appendix 2.

7.0 RESULTS

7.1 Temperature Survey

Results of the temperature survey indicate that the various components of the 10 KW 60 Hz Generator Set ran satisfactorily within the high temperature environment of the acoustic enclosure. The modifications of section 6.1 must be met for prolonged use of the unit.

7.2 Acoustical Evaluation

The sound pressure level measurements taken for the "F" kit enclosure show that the catagory F requirements of MIL-STD-1474 were met for all frequencies below the 1000 Hz octave band. Although the target levels at and above the 1000 Hz octave band were not met, the results of the acoustic tests show that the "F" kit provides a reduction in sound pressure level at these frequencies of at least 10 dB below the standard set baseline data shown in Figures 24 and 25.

8.0 CONCLUSIONS

Evaluation of the preproduction "F" kit has shown that it is feasible to produce a bolt-on type acoustic enclosure for the 10 KW GTED Generator Set. If a contract was awarded for a 10 KW Generator Set with silent watch capability, the present enclosure design could be applied to the standard 10 KW GTED generator set and provide a significant attenuation of sound pressure level in the audio frequency range.

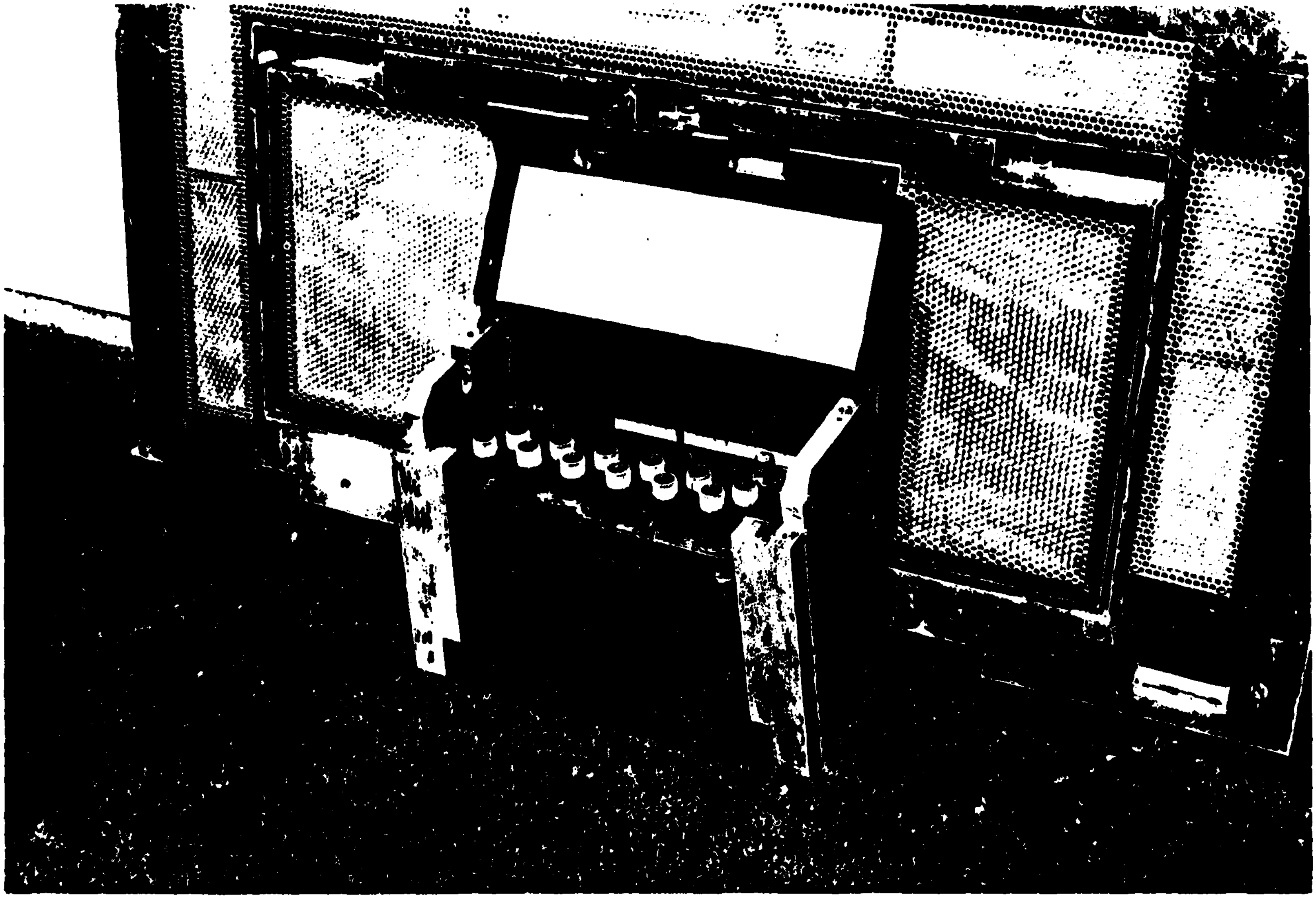


Figure 1. Original Battery Box Concept

Figure 2. Battery Box Orientation

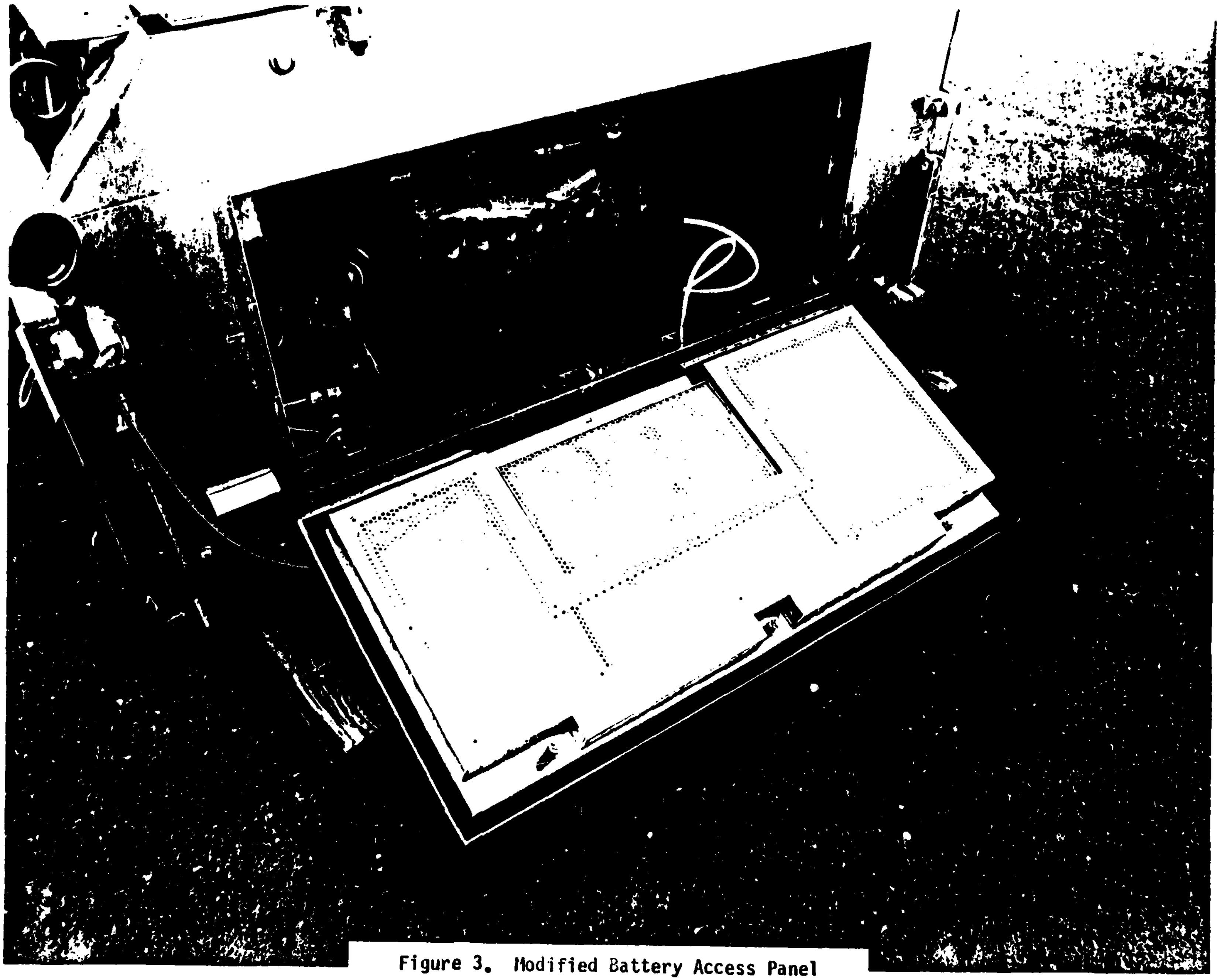


Figure 3. Modified Battery Access Panel

Figure 4. Assembled Preproduction "F" Kit Acoustic Housing

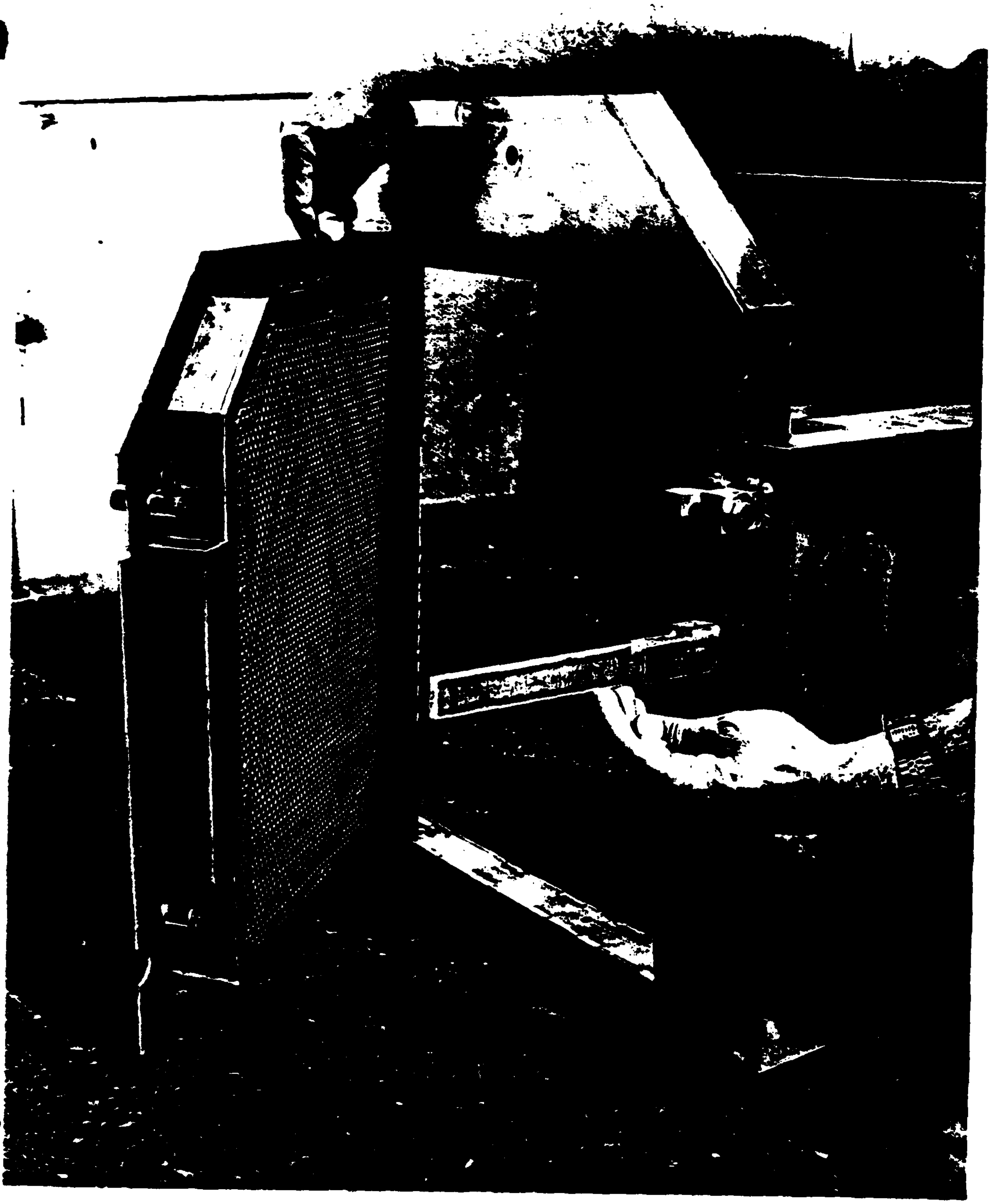


Figure 5. Access Panel and Lifting Handle Construction

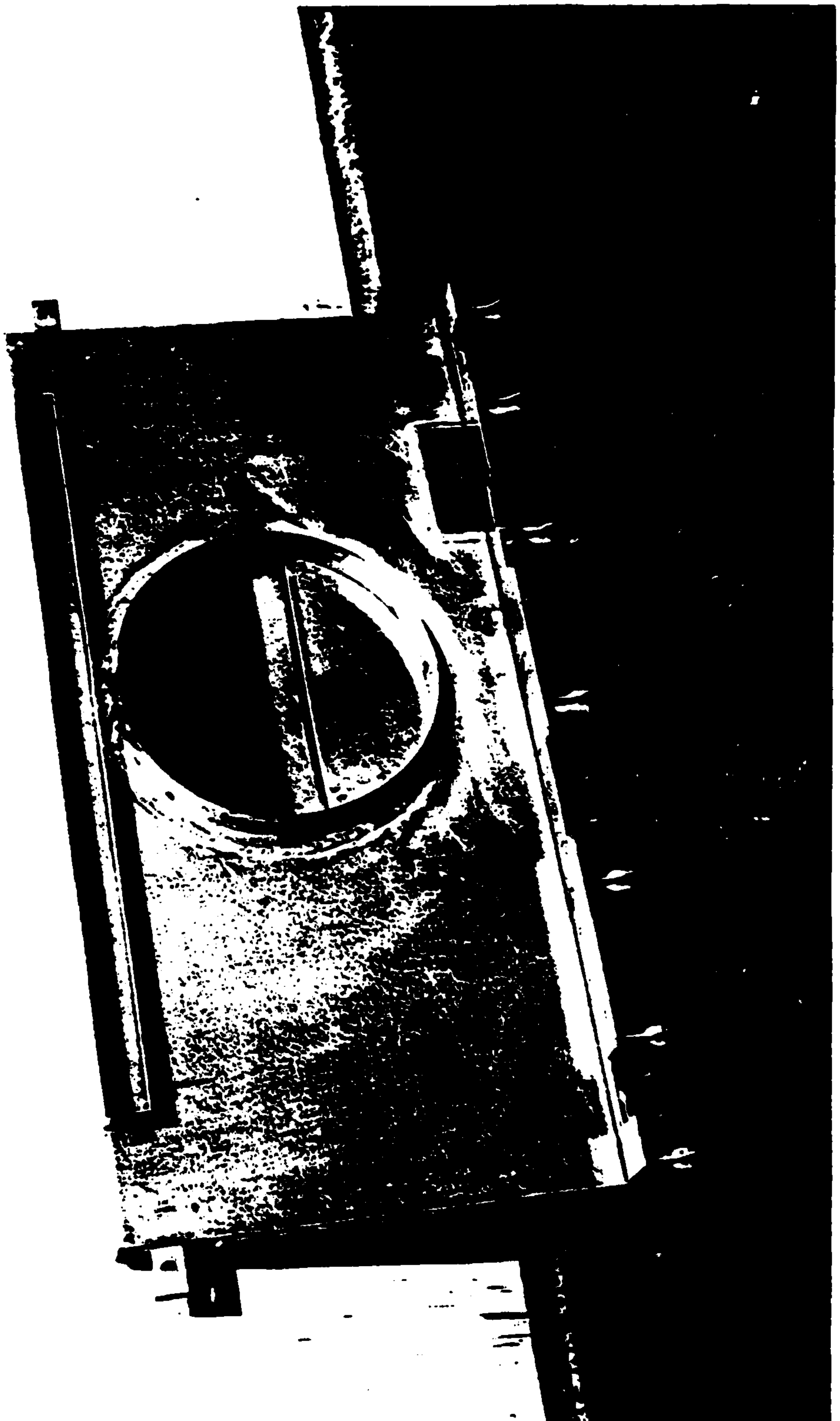


Figure 6. Forward Panel

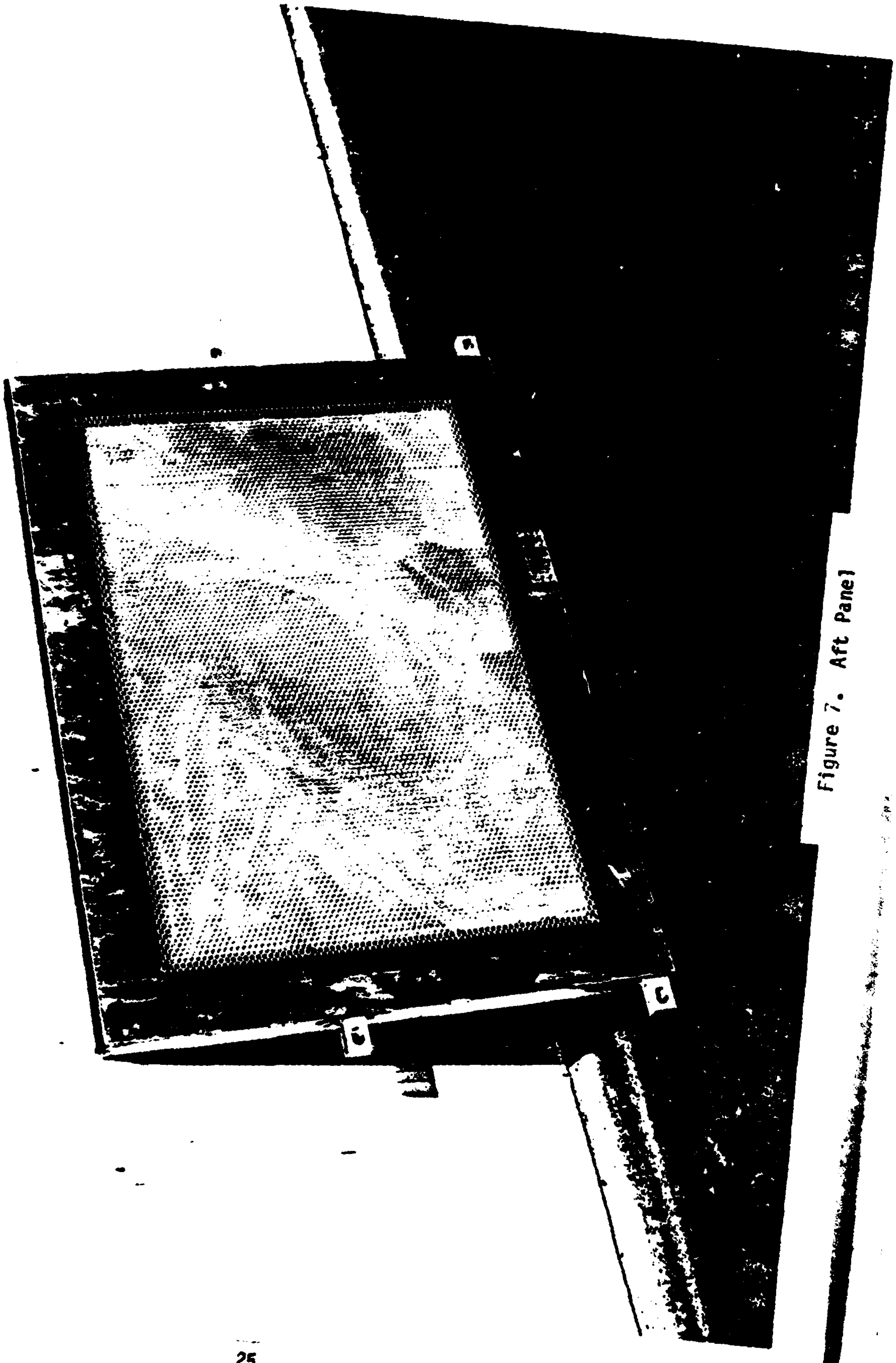


Figure 7. Aft Panel

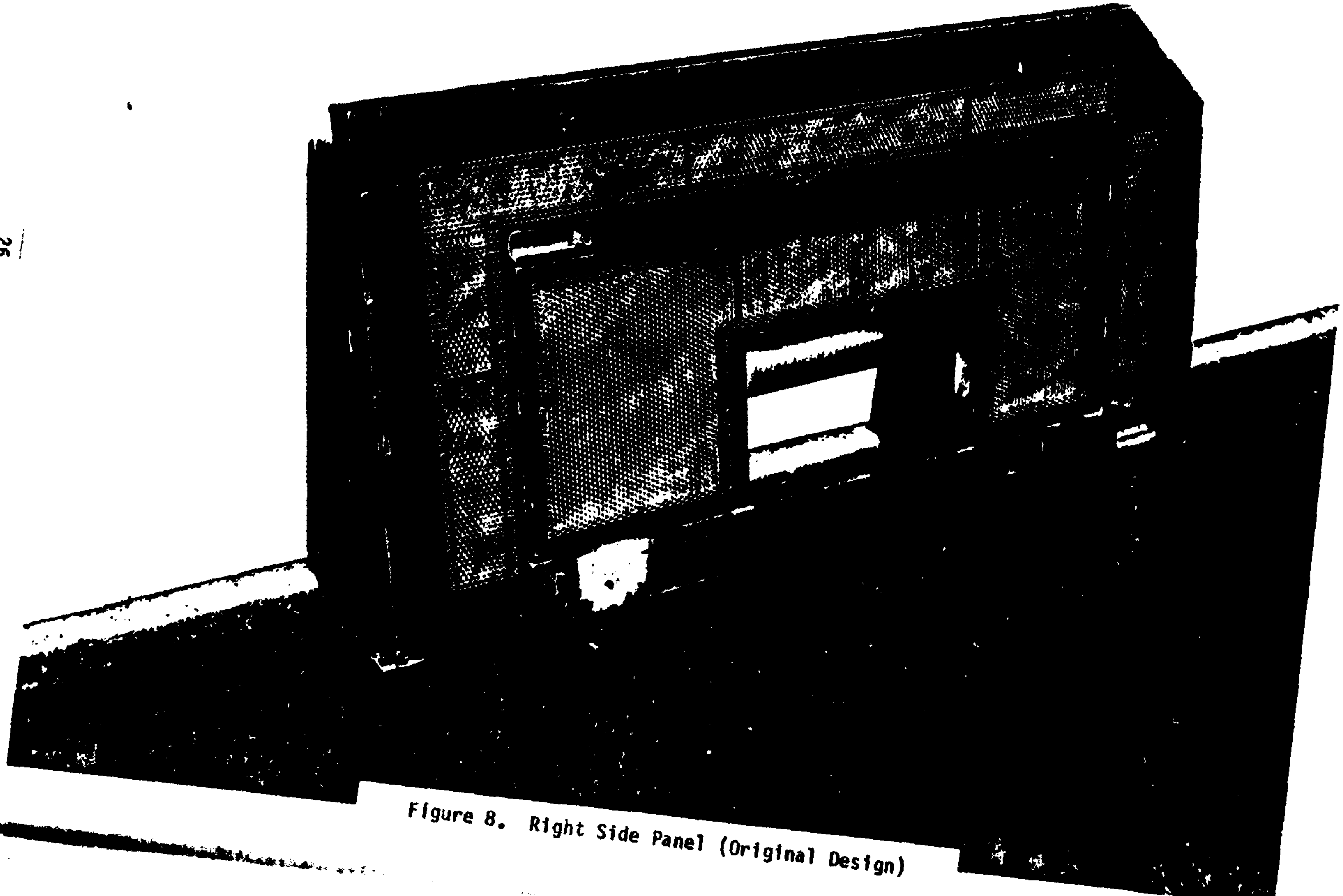


Figure 8. Right Side Panel (Original Design)

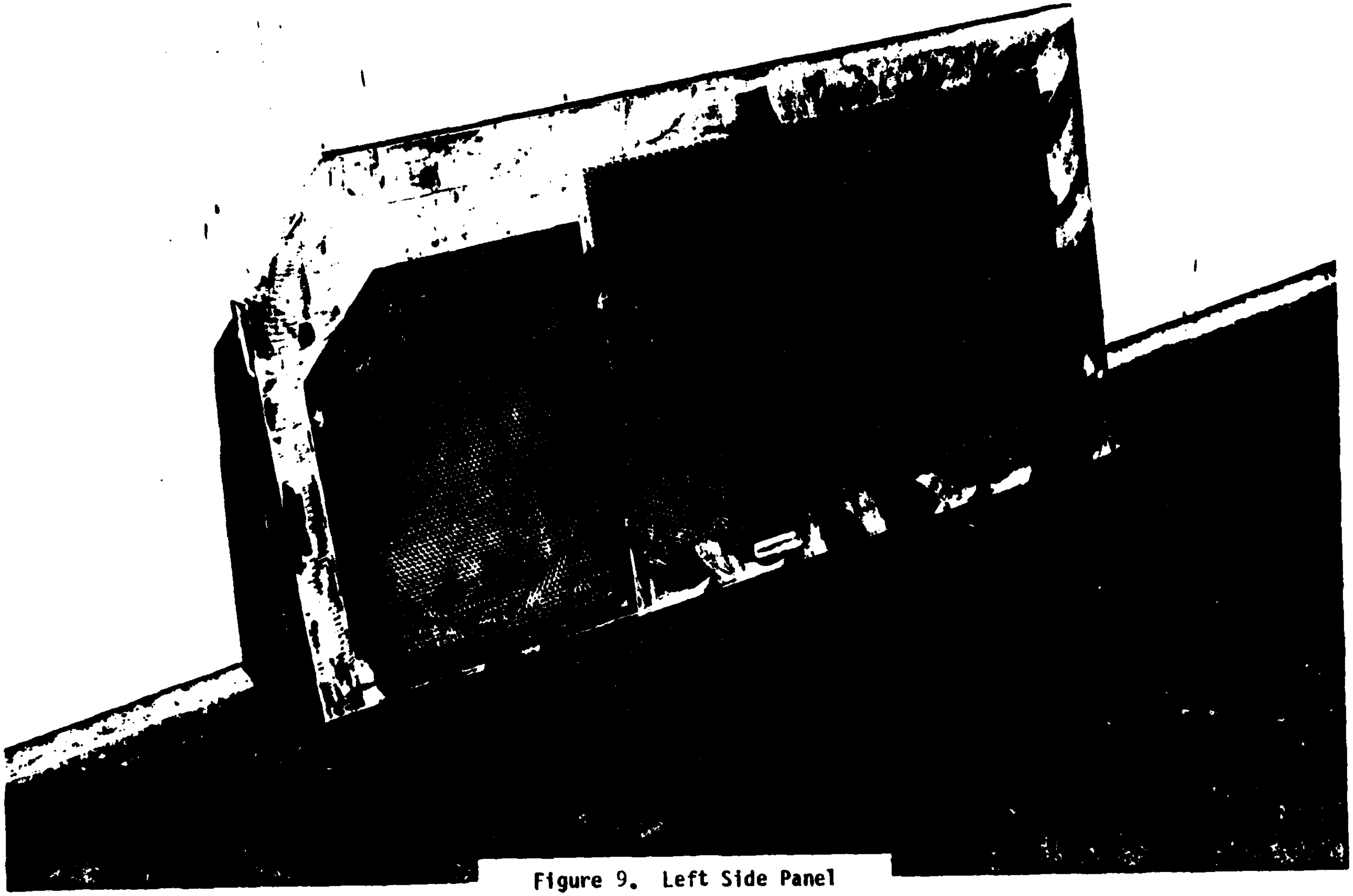


Figure 9. Left Side Panel

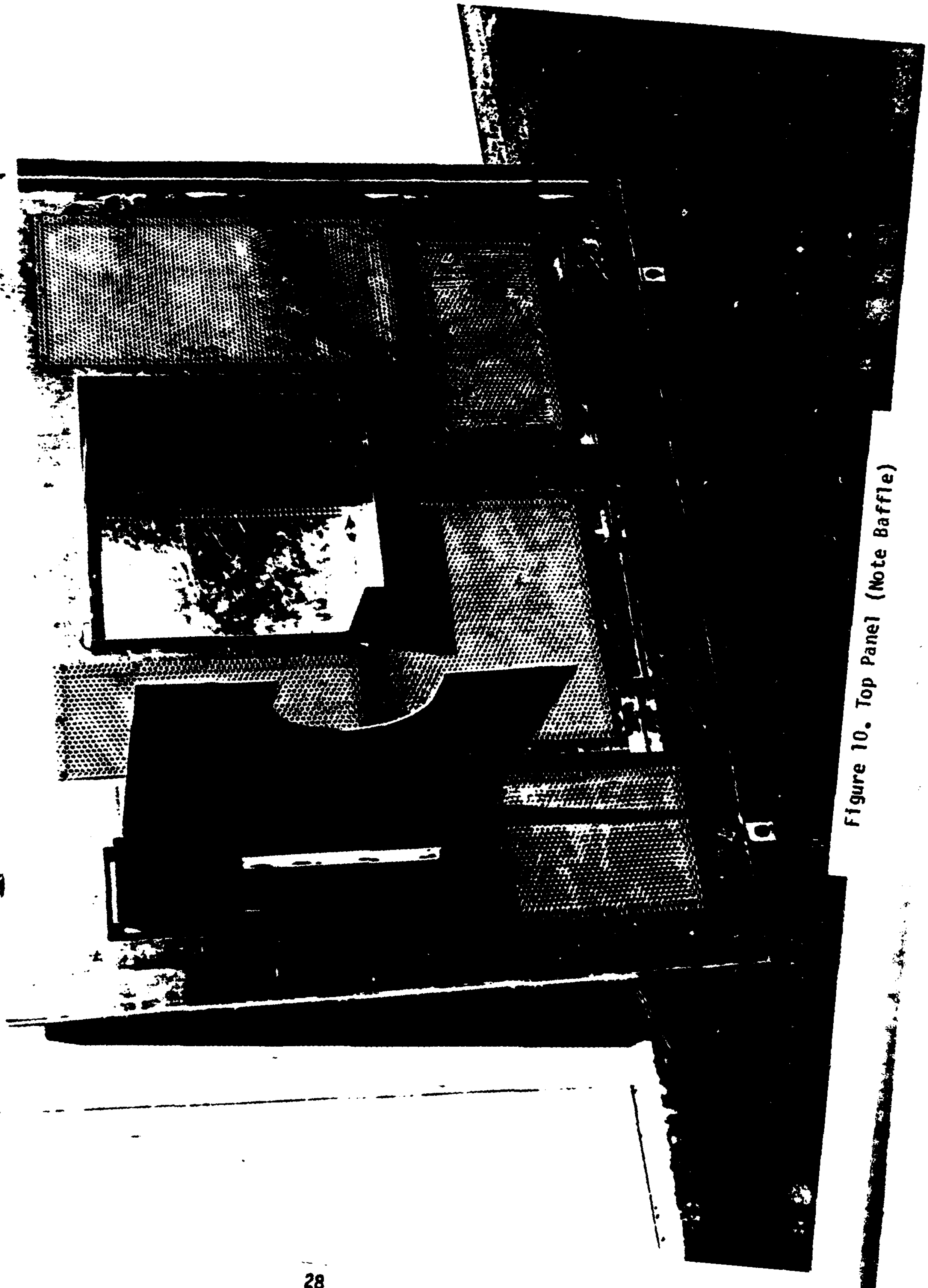


Figure 10. Top Panel (Note Baffle)

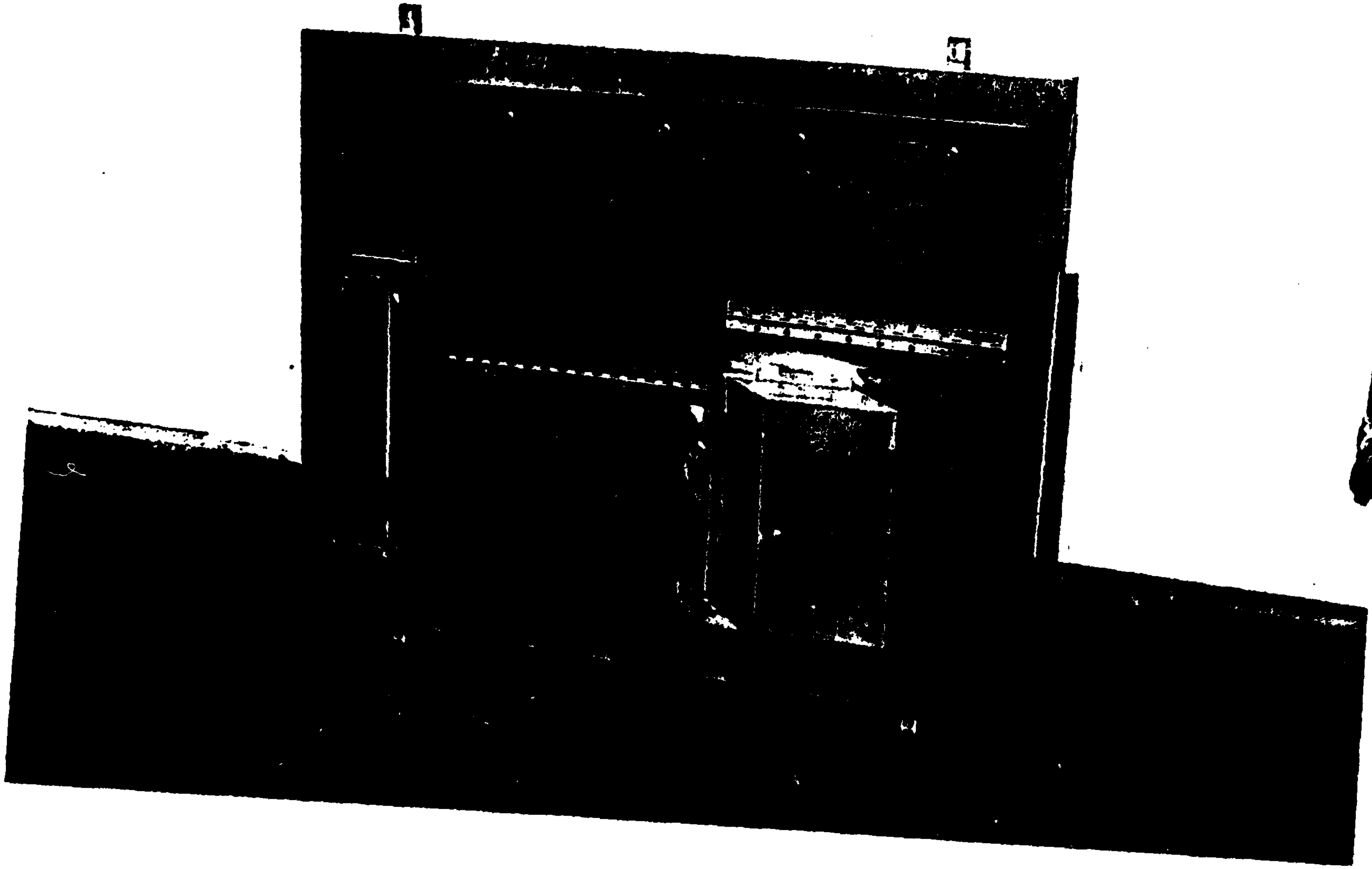


Figure 11. Top Panel

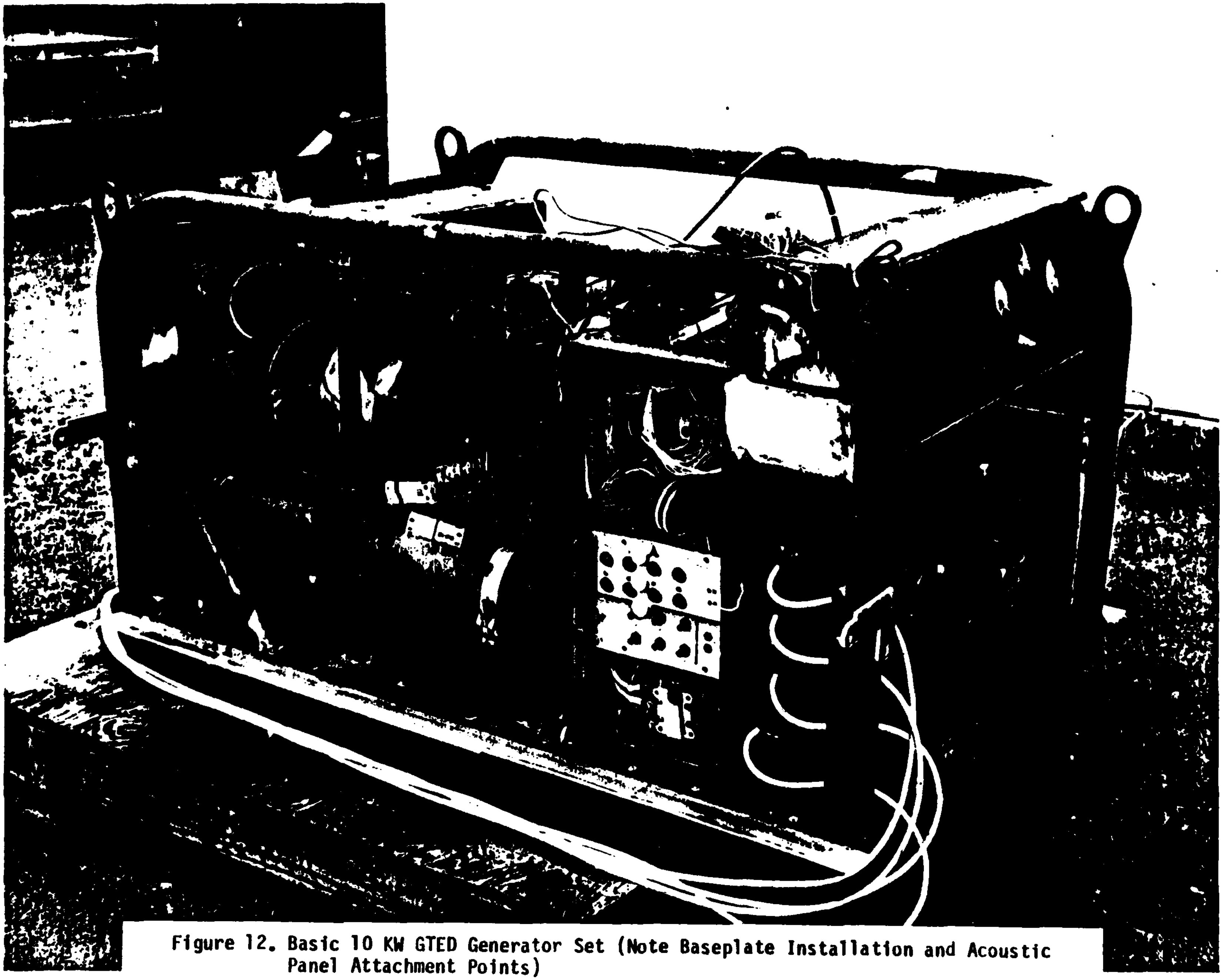


Figure 12. Basic 10 KW GTED Generator Set (Note Baseplate Installation and Acoustic Panel Attachment Points)

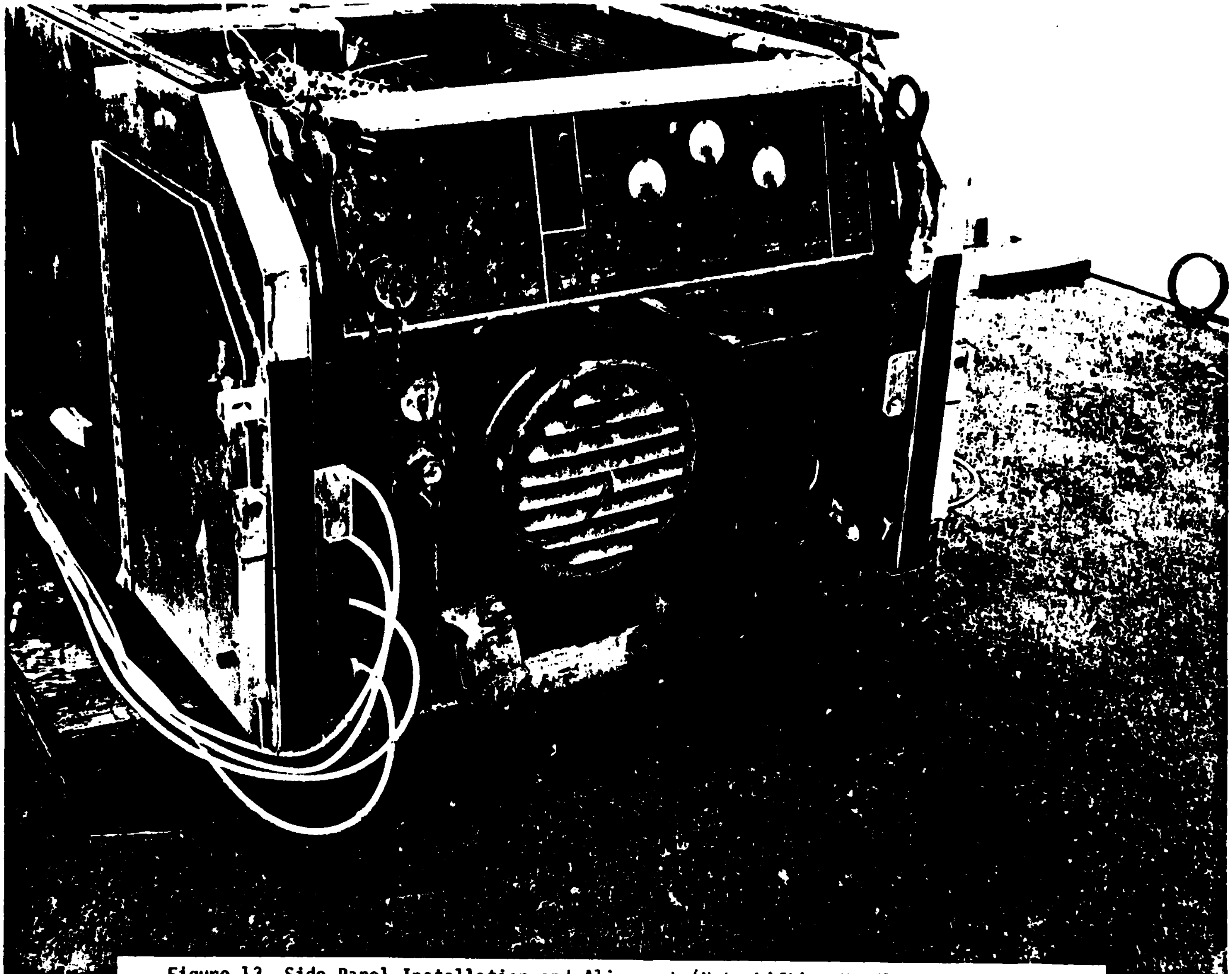


Figure 13. Side Panel Installation and Alignment (Note Lifting Handle Installation)

Figure 14. Forward Panel Installation (Note Load Cable Routing)

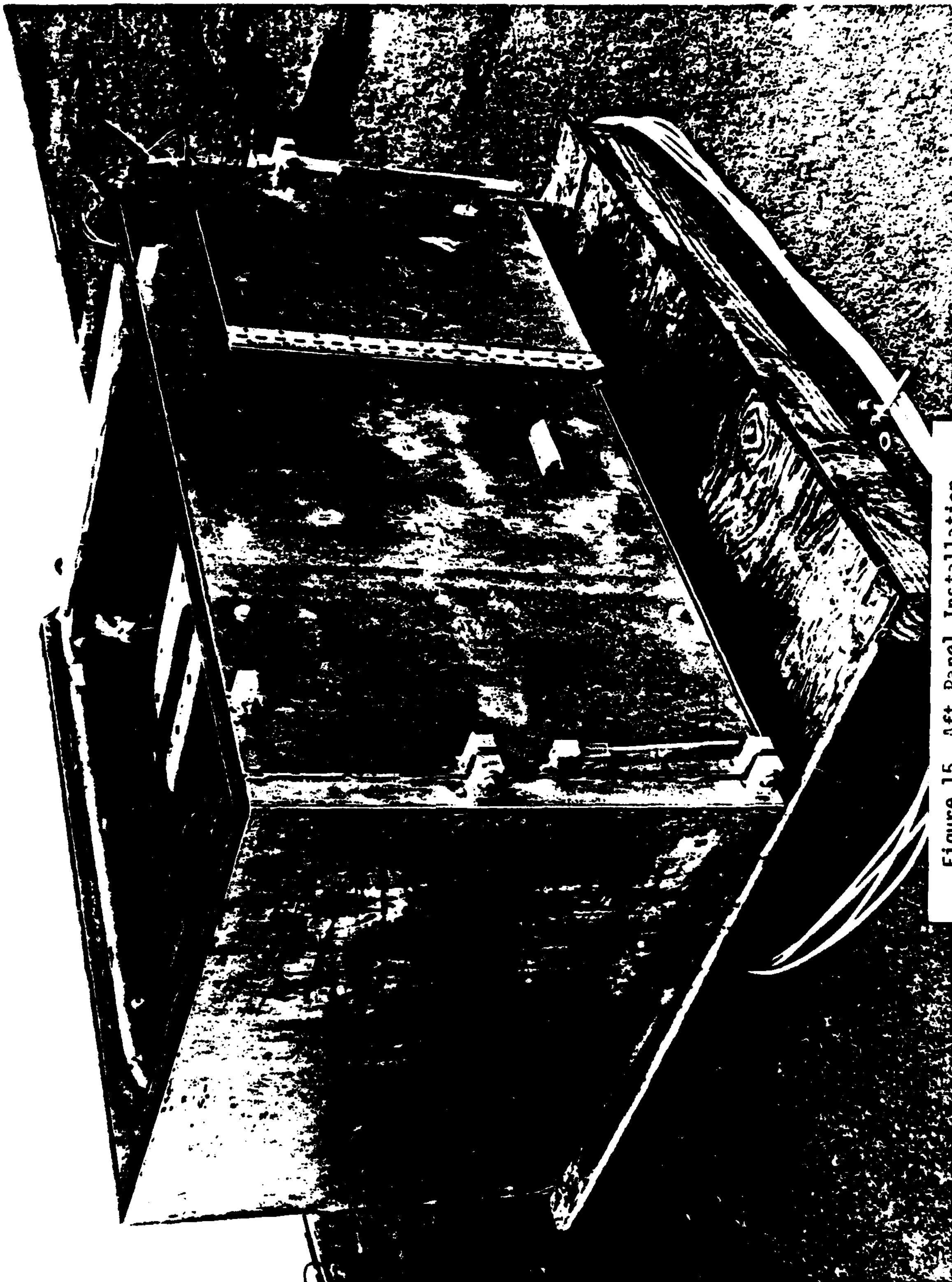


Figure 15. Aft Panel Installation

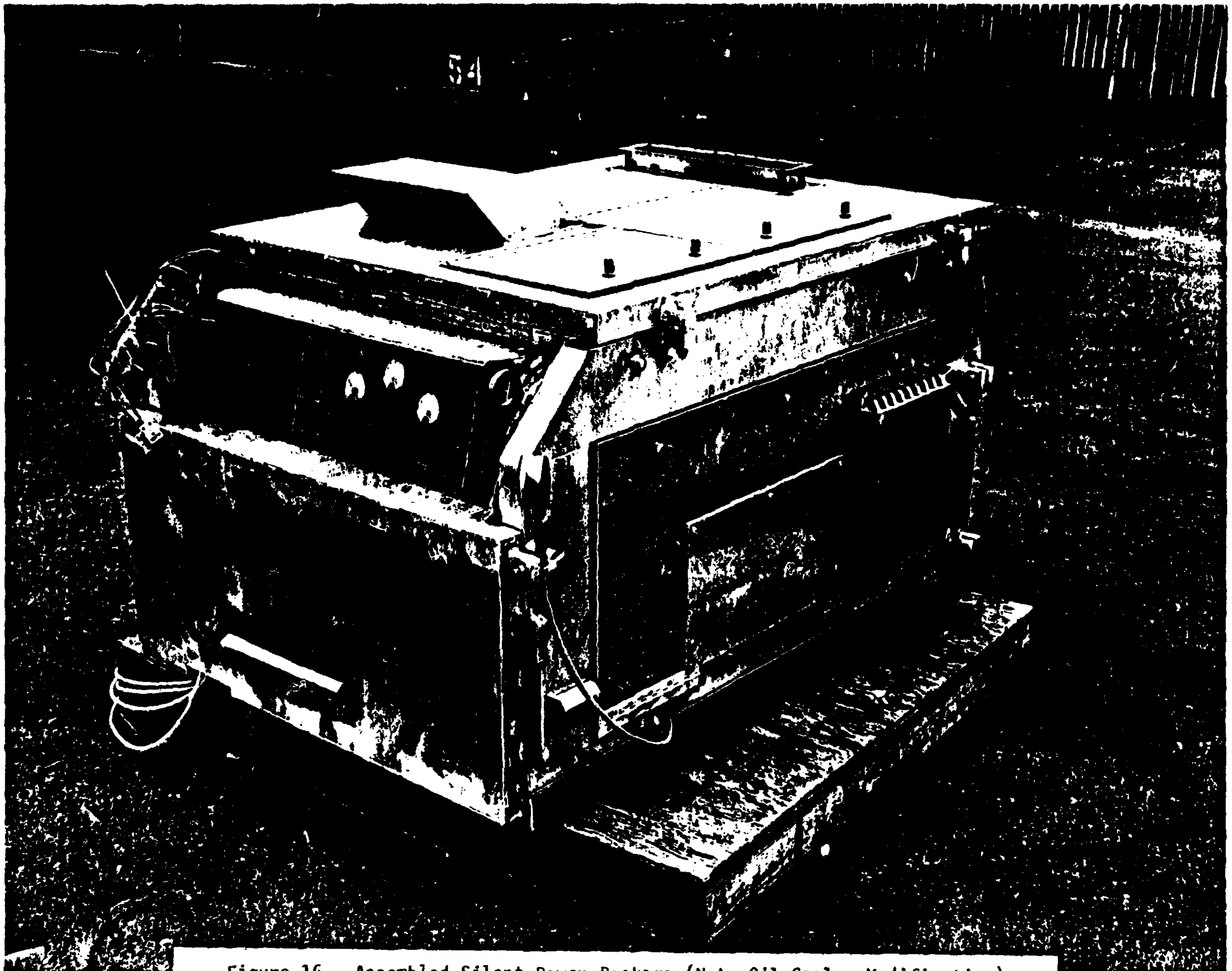
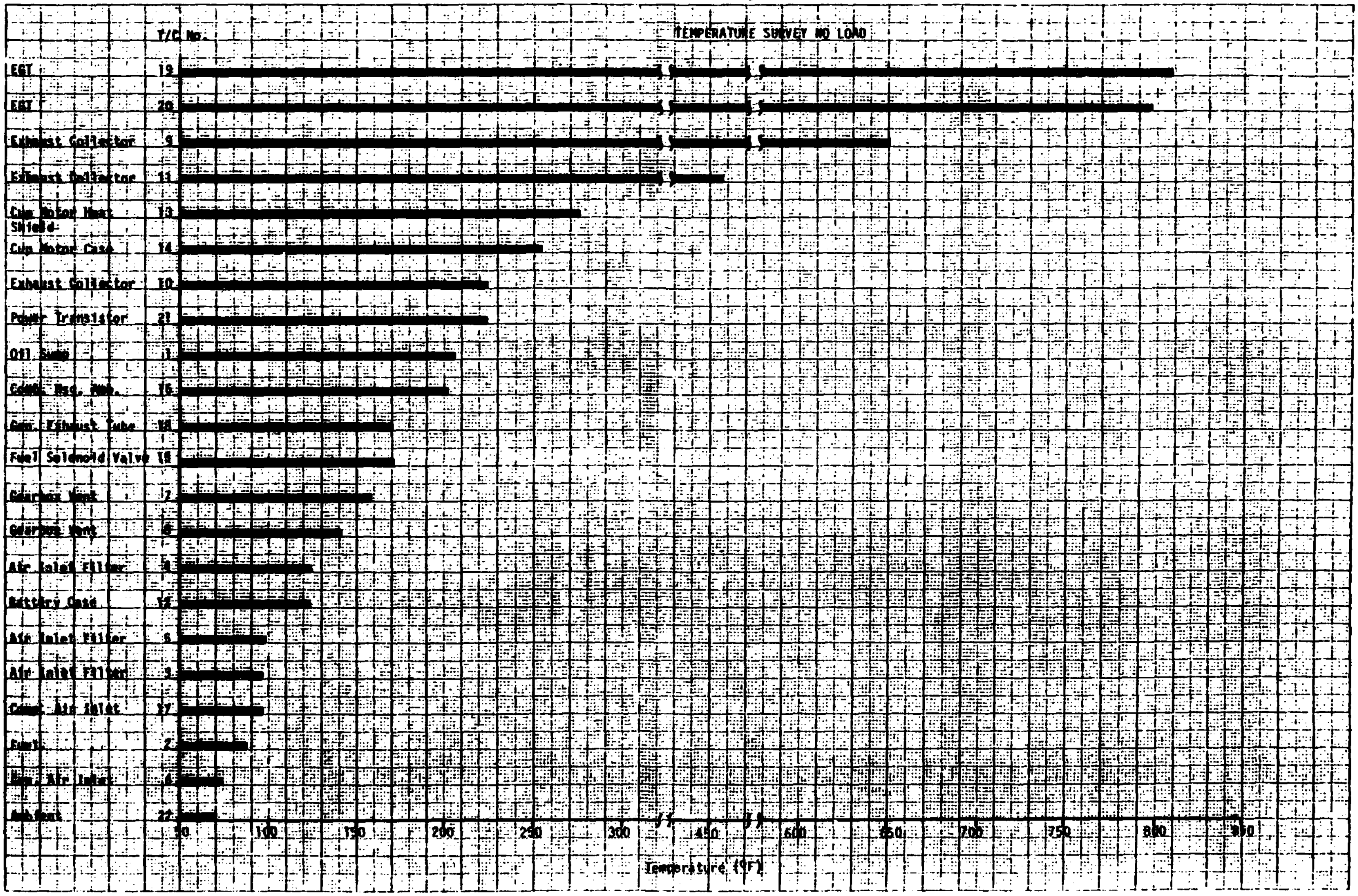


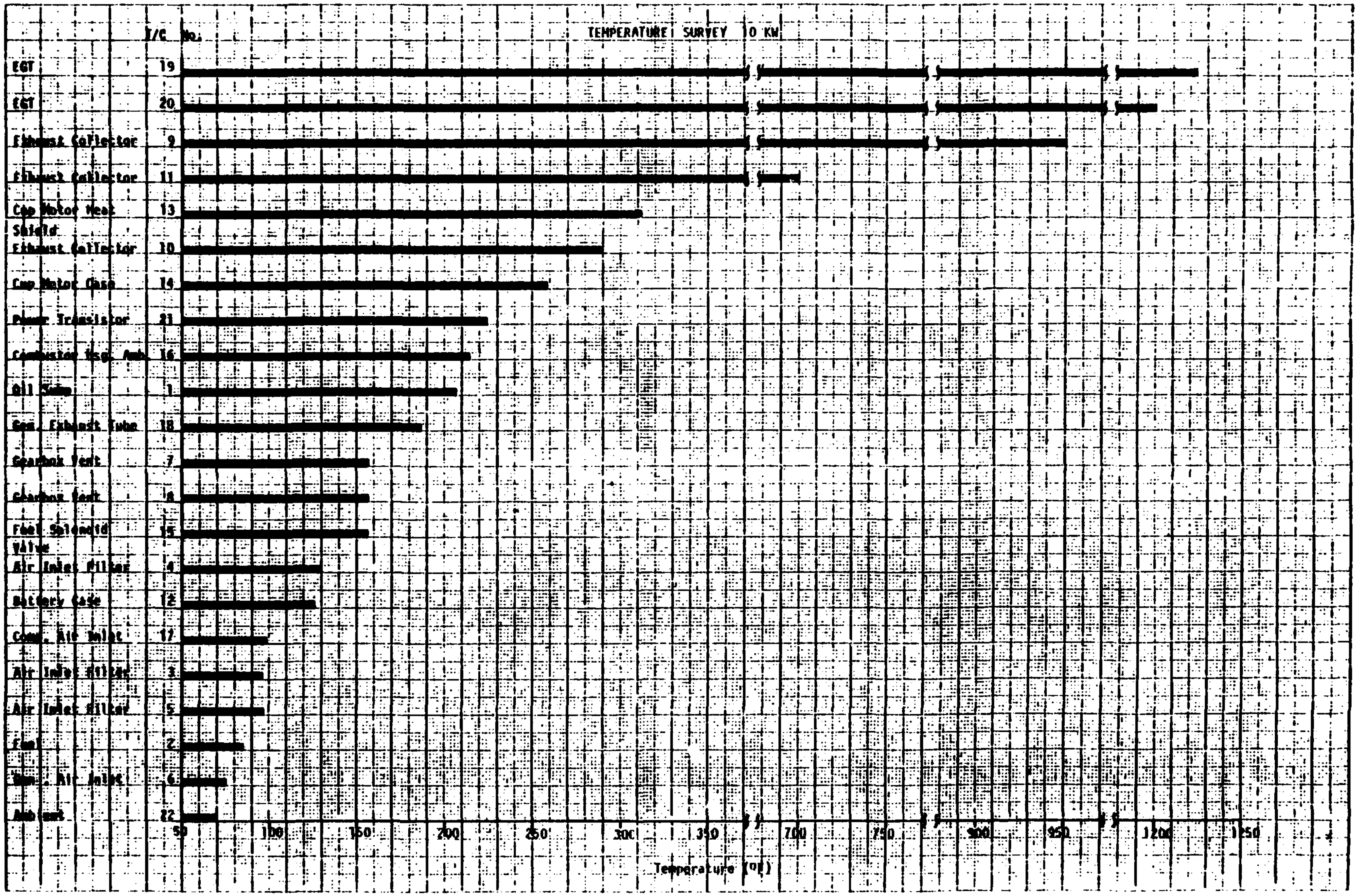
Figure 16. Assembled Silent Power Package (Note Oil Cooler Modification)

Figure 17



T/C No.
TEMPERATURE SURVEY NO LOAD
EGT 19
EGT 20
Exhaust Collector 9
Exhaust Collector 11
Gen Motor Heat Shield 13
Gen Motor Case 14
Exhaust Collector 10
Power Transistor 21
Oil Sump 1
Comb. Hsg. Amb. 16
Gen. Exhaust Tube 18
Fuel Solenoid Valve 18
Gearbox Vent 7
Gearbox Vent 6
Air Inlet Filter 4
Battery Case 15
Air Inlet Filter 5
Air Inlet Filter 3
Comb. Air Inlet 17
Fuel 2
Gen. Air Inlet 6
Ambient 22
50
100
150
200
250
300
450
600
650
700
750
800
850
Temperature (°F)

Figure 18


TEMPERATURE SURVEY 10 KW
T/C No.
EGT 19
EGT 20
Exhaust Collector 9
Exhaust Collector 11
Cap Motor Heat Shield 13
Exhaust Collector 10
Cap Motor Case 14
Power Transistor 21
Combustor Hsg. Amb. 16
Oil Sump 1
Gen. Exhaust Tube 18
Gearbox Vent 7
Gearbox Vent 8
Fuel Solenoid Valve 15
Air Inlet Filter 4
Battery Case 12
Comb. Air Inlet 17
Air Inlet Filter 3
Air Inlet Filter 5
Fuel 2
Gen. Air Inlet 6
Ambient 22
50
100
150
200
250
300
350
700
750
900
950
1200
1250
Temperature (°F)

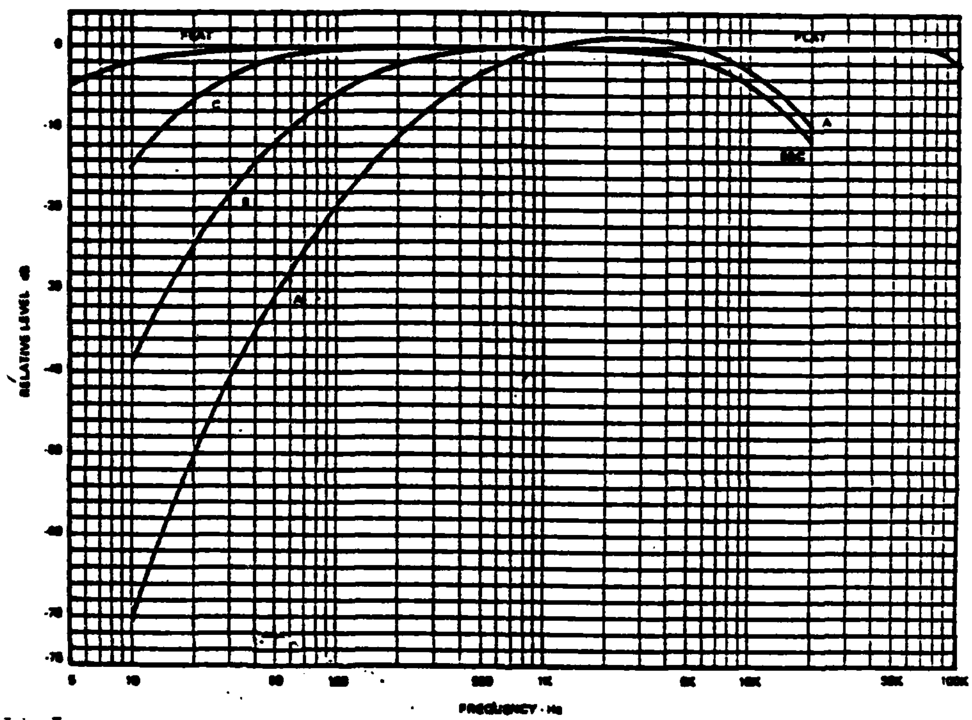
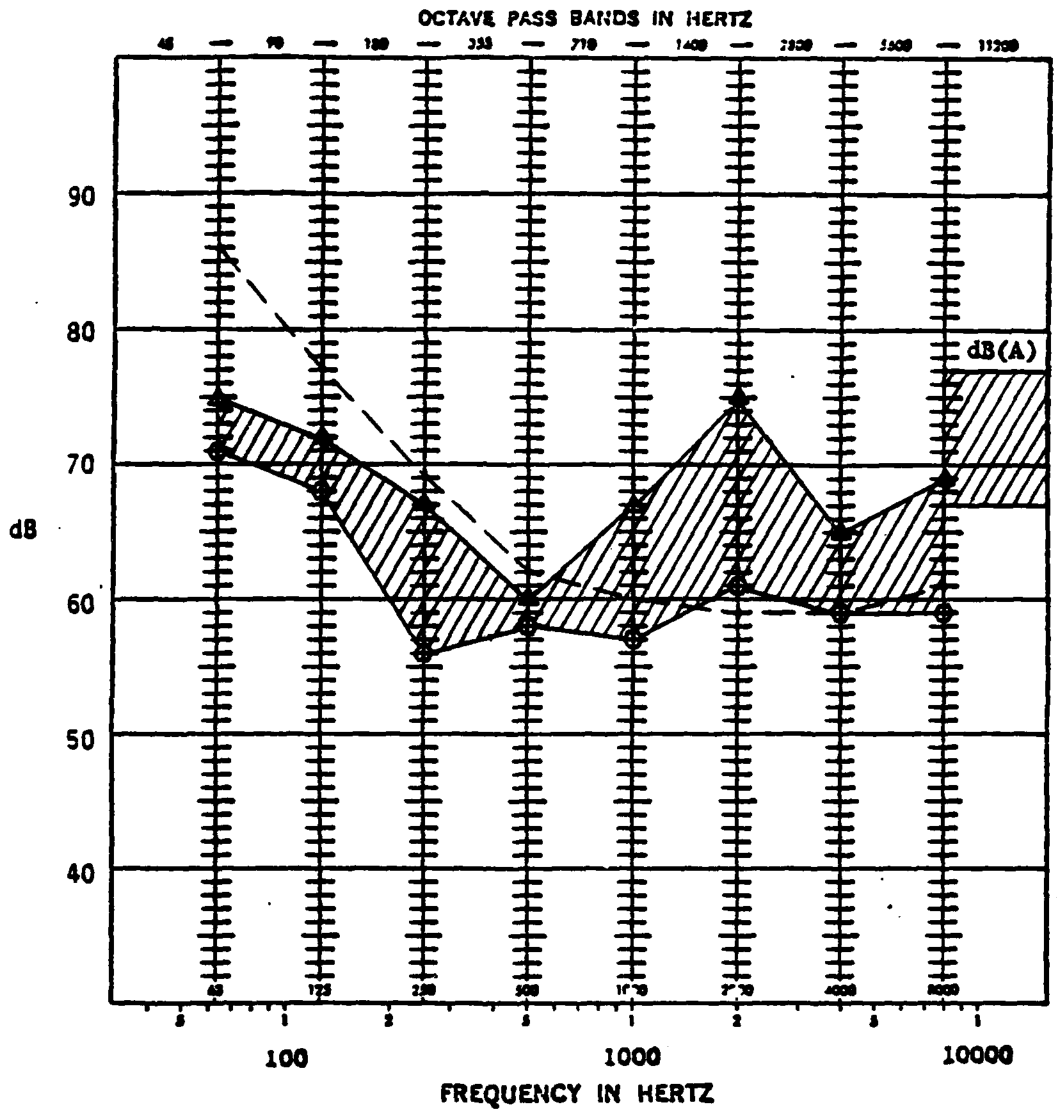


Figure 19 Frequency Response Characteristics for General Radio Model 1558 Sound Level Meter

FIGURE 20
SOUND PRESSURE LEVEL
PREPRODUCTION "F" KIT
NO LOAD @ 6 METERS



— — Catagory F Noise Limit
△ Highest Sound Pressure Measured
O Lowest Sound Pressure Measured
Wind Condition: Calm

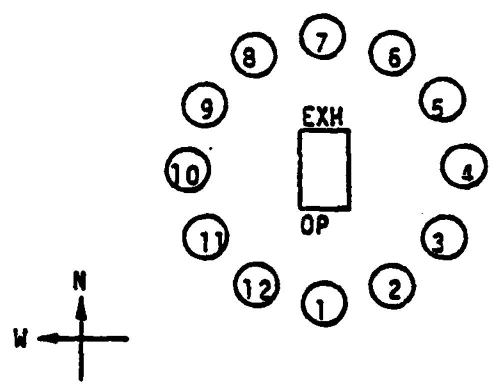
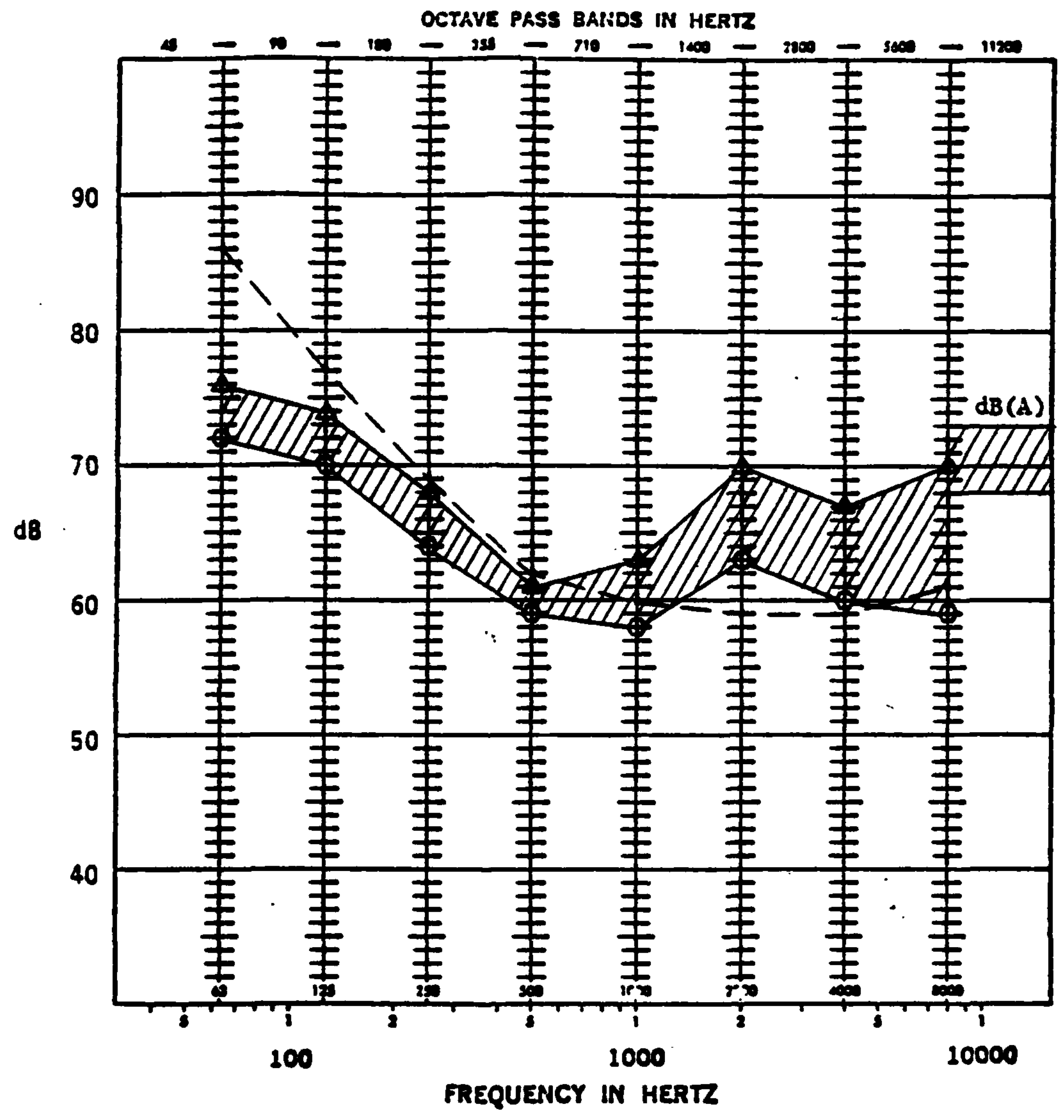


FIGURE 21
SOUND PRESSURE LEVEL
PREPRODUCTION "F" KIT
10 KW @ 6 METERS



Catagory F Noise Limit

△ Highest Sound Pressure Measured

○ Lowest Sound Pressure Measured

Wind Condition: Calm

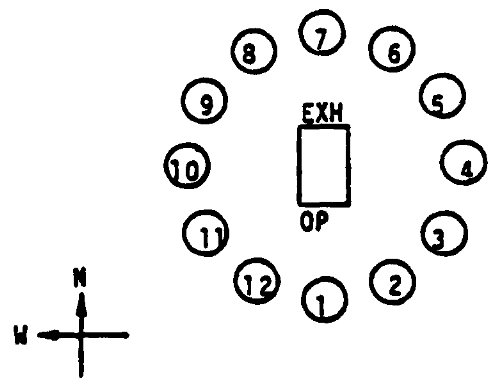
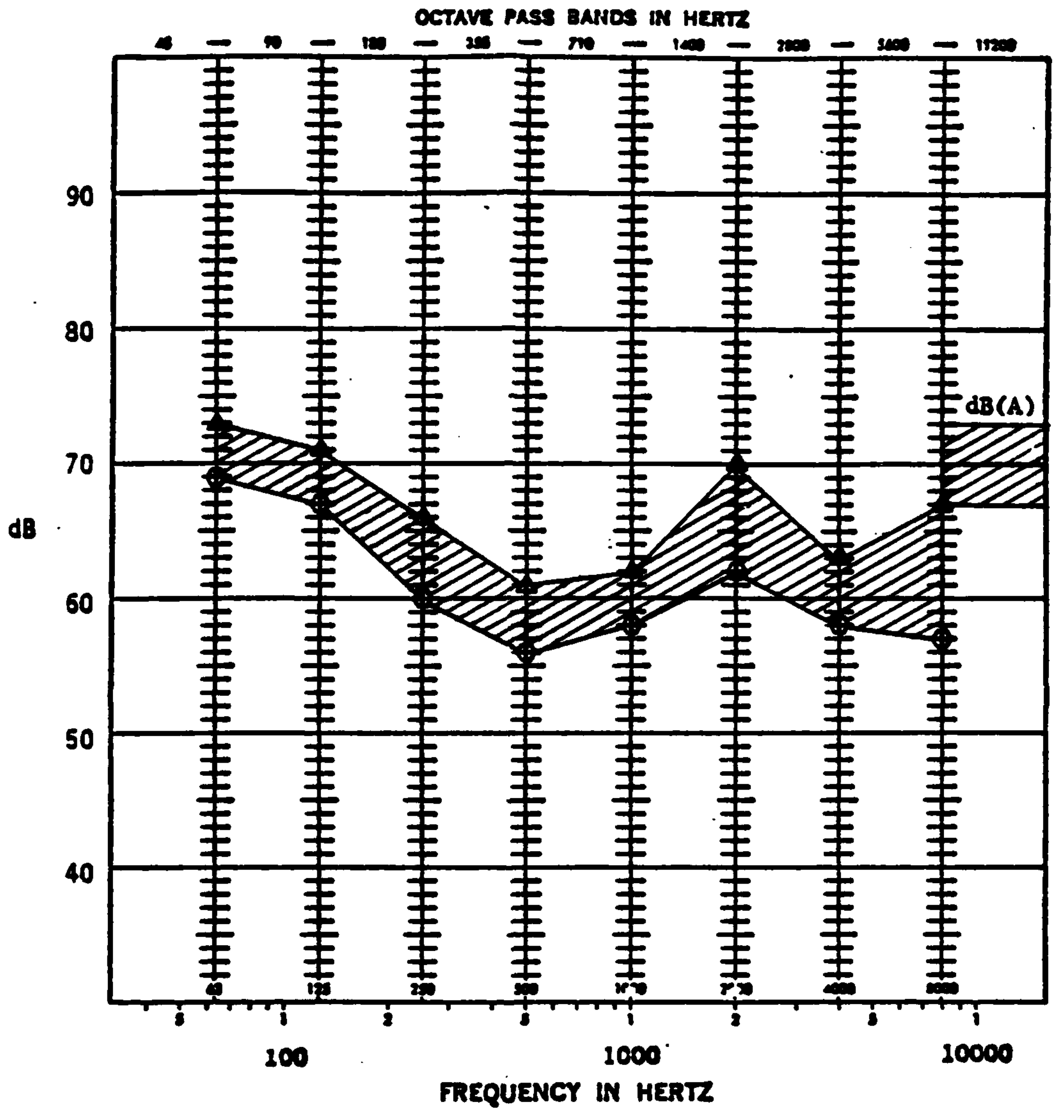


FIGURE 22
SOUND PRESSURE LEVEL
PREPRODUCTION "F" KIT
NO LOAD @ 7 METERS



△ Highest Sound Pressure Measured
○ Lowest Sound Pressure Measured
Wind Condition: Calm

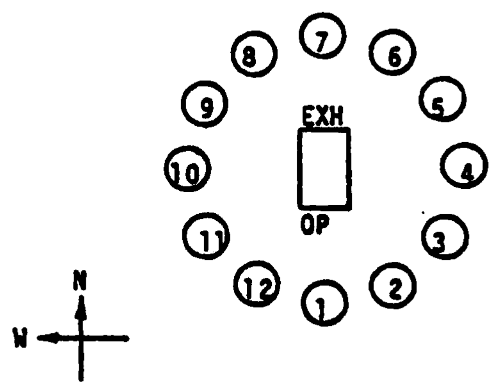
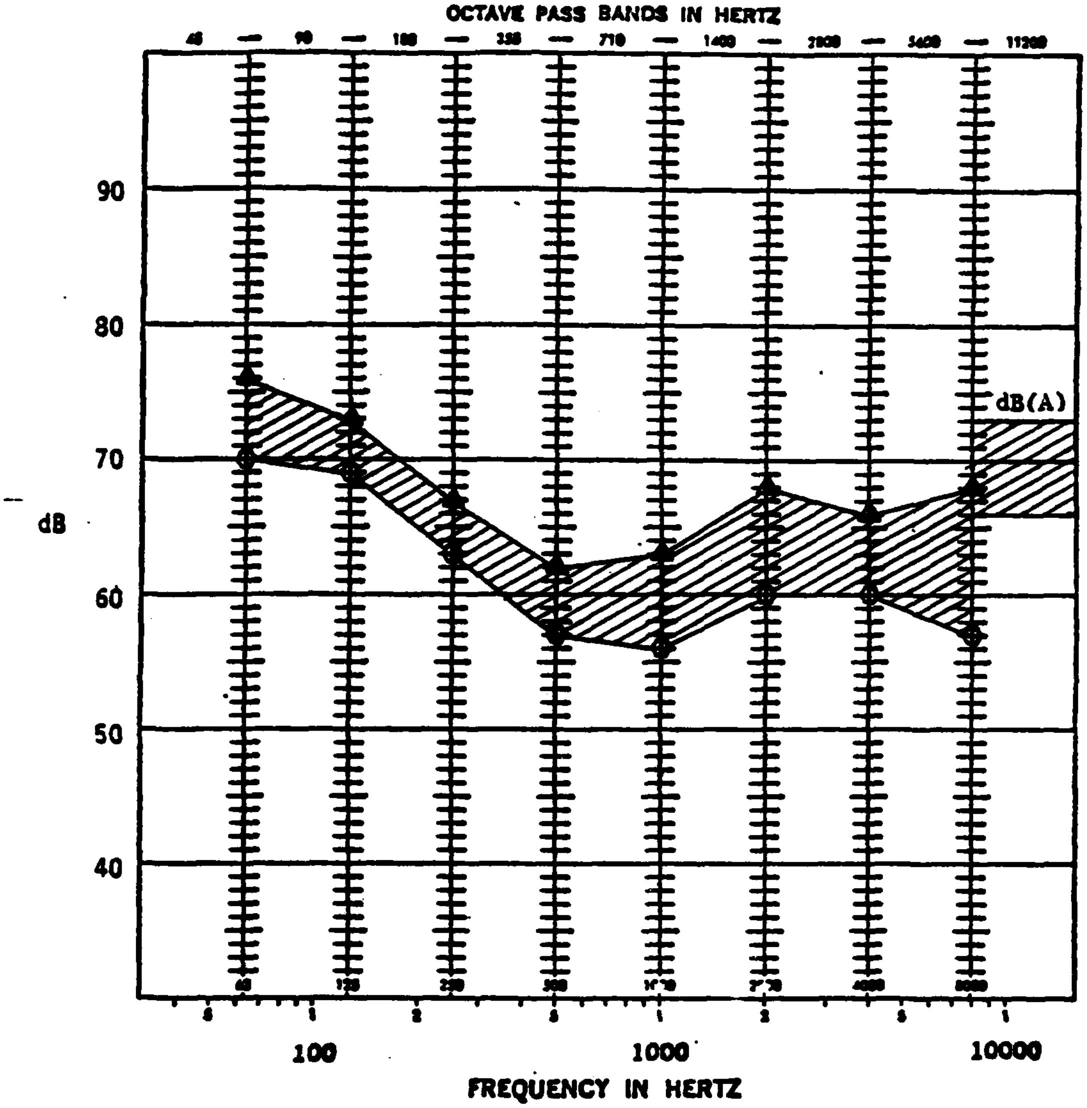


FIGURE 23
SOUND PRESSURE LEVEL
PREPRODUCTION "F" KIT
10 KW @ 7 METERS



△ Highest Sound Pressure Measured
○ Lowest Sound Pressure Measured
Wind Condition: Calm

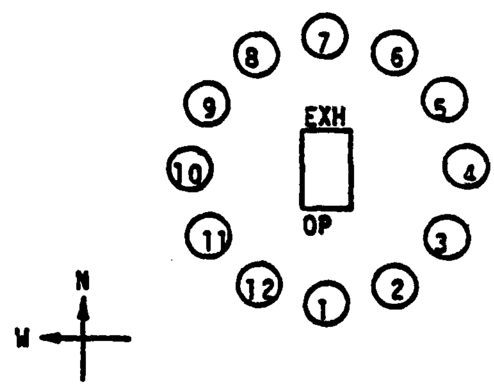
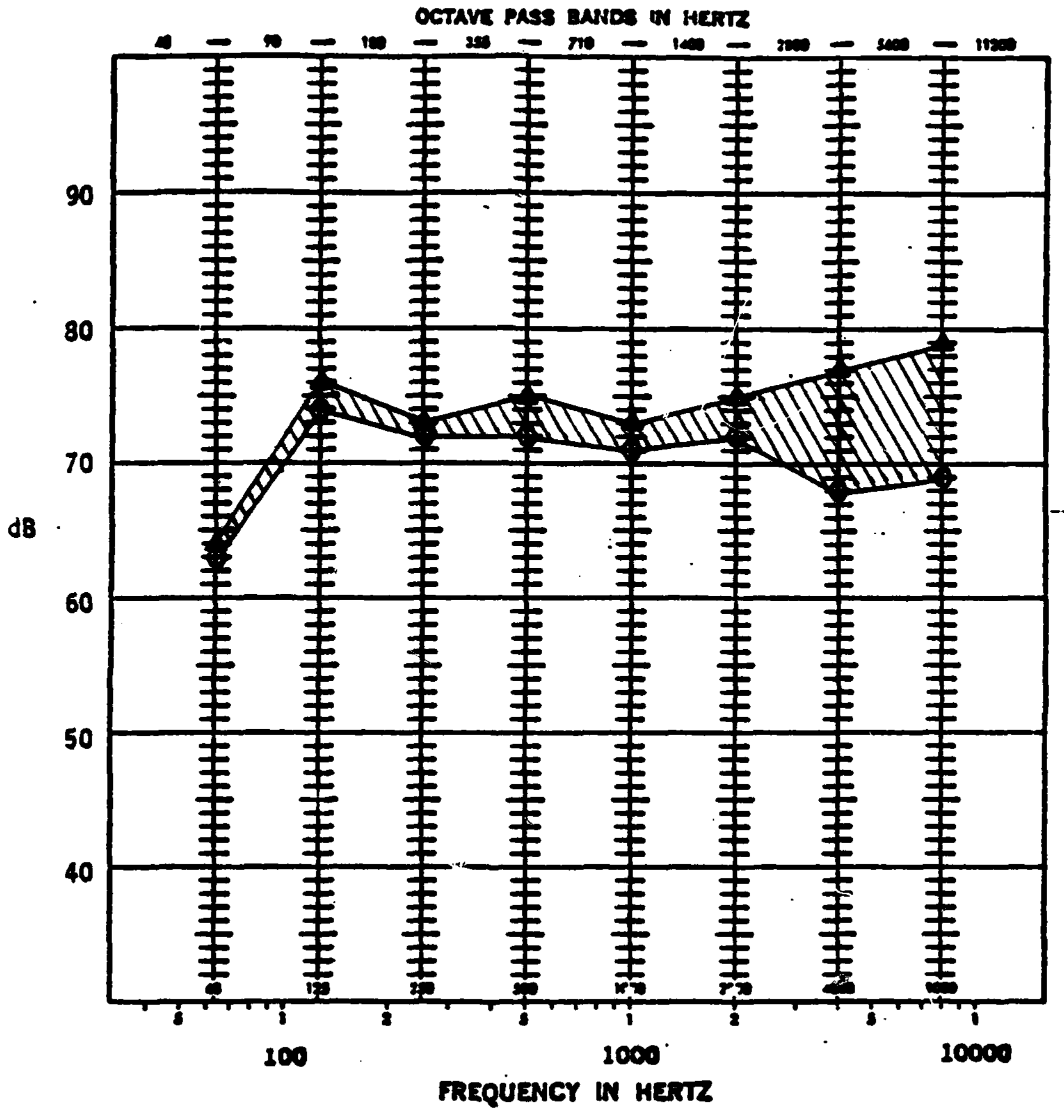


FIGURE 24
SOUND PRESSURE LEVEL
STANDARD SET BASELINE
NO LOAD @ 6 METERS



△ Highest Sound Pressure Measured
○ Lowest Sound Pressure Measured

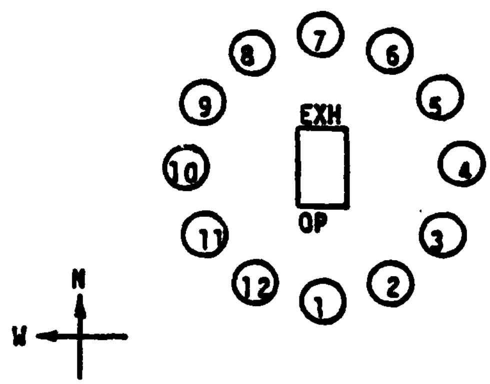
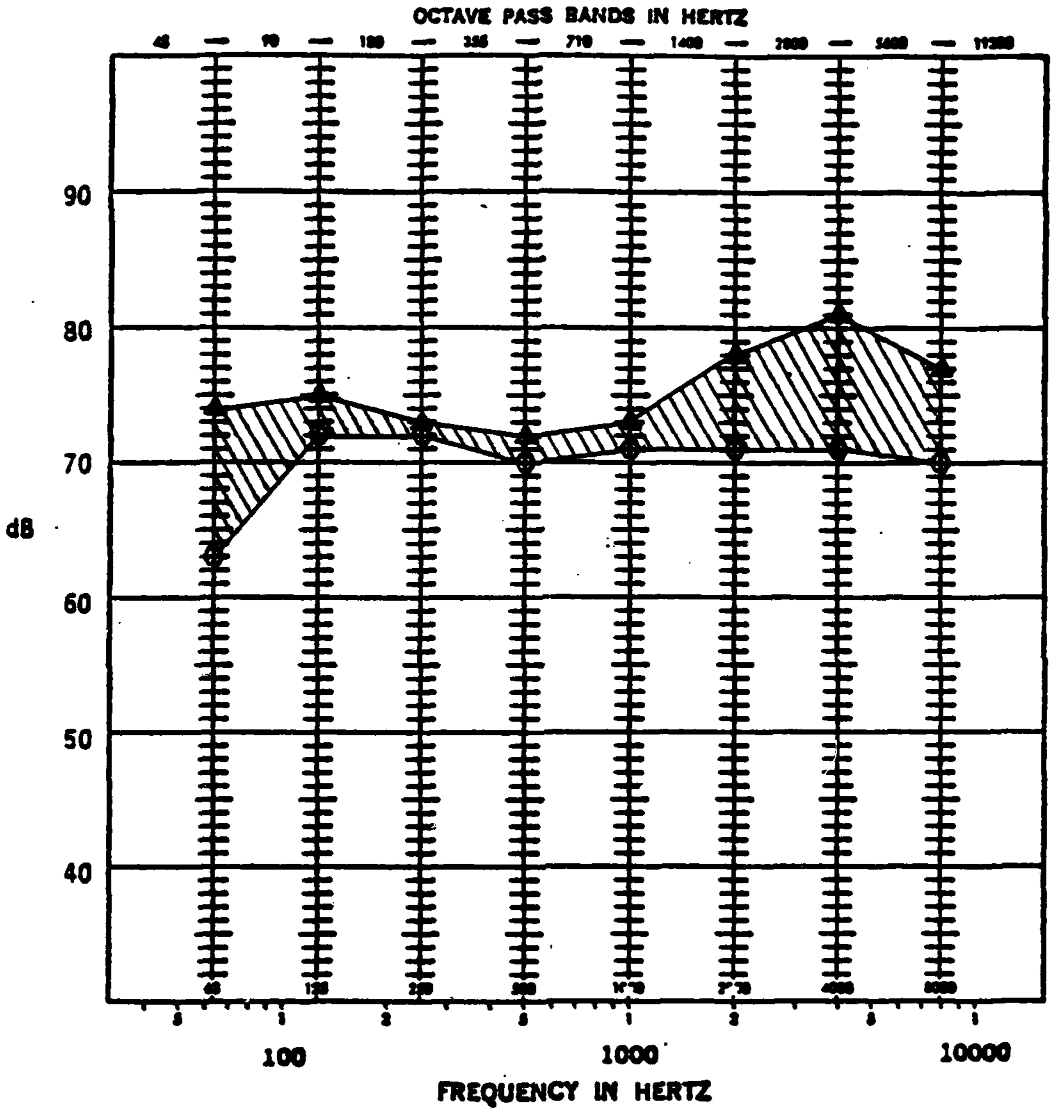
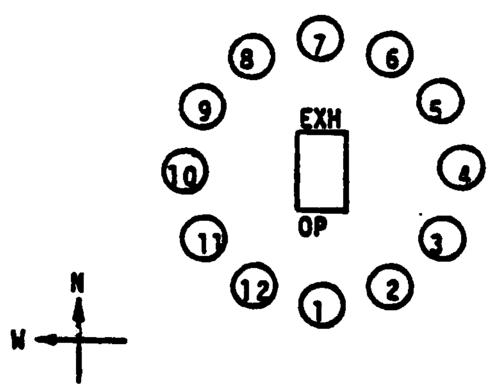


FIGURE 25
SOUND PRESSURE LEVEL
STANDARD SET BASELINE
10 KW @ 6 METERS



△ Highest Sound Pressure Measured
○ Lowest Sound Pressure Measured



APPENDIX I

OFFICIAL TEST RECORD

SOLAR TURBINES INTERNATIONAL
An Operating Group of International Harvester

MFGR RADIAL ENGINE DIVISION
MODEL 10 KW GTED
SERIAL NO.
RATING

CONTRACT NO. DAAK 70-77-C-0032

AUDIO NOISE
"F" KIT - 6 METER
NO LOAD

TEST NO.
DATE 1-14-82
TESTED BY BUTZKE/PHAM
INSP.

INST #	.																			
READ NO.	TIME	FREQ	AMB	1	2	3	4	5	6	7	8	9	10	11	12		OP			AVG AMB TEMP
UNITS		Hz	db	db	db	db	db	db	db	db	db	db	db	db	db		db			°F
FACTOR																				
		63	62	74	71	73	74	75	75	74	74	74	74	73	72		81			
		125	62	71	71	70	68	69	69	69	72	68	68	69	70		76			
		250	57	67	56	64	64	63	63	63	62	62	63	63	64		74			
		500	49	60	59	58	58	60	59	58	58	58	59	59	59		72			
		1000	48	61	62	61	62	58	67	61	62	57	62	60	61		72			
		2000	<44	15	69	69	71	62	75	65	68	61	69	64	65		77			
		4000	<44	65	64	61	59	62	61	63	61	61	59	63	64		76			
		8000	<44	69	15	62	60	62	63	64	63	60	59	63	66		79			
		OA	71	78	77	77	77	77	80	79	77	77	77	76	77		87			
			72																	
		db(A)	52	72	73	71	72	68	77	70	71	67	71	70	71		84			
			58																	

REMARKS

Sheet ____ of ____

SADI 2126

MFGR RADIAL ENGINE DIVISION

MODEL 10 KW GTED

SERIAL NO. ____

RATING ____

CONTRACT NO. DAAK 70-77-C-0032

OFFICIAL TEST RECORD

SOLAR TURBINES INTERNATIONAL
An Operating Group of International Harvester

AUDIO NOISE
"F" KIT - 6 METER
10 KW LOAD

TEST NO. ____

DATE 1-14-82

TESTED BY BUTZKE / PHAM

INSP. ____

INST # / READ NO.	TIME	FREQ	AMB	1	2	3	4	5	6	7	8	9	10	11	12		OP			AVG AMB TEMP
UNITS		Hz	db	db	db	db	db	db	db	db	db	db	db	db	db		db			°F
FACTOR																				
		63	.59	72	72	72	75	76	76	74	76	74	74	74	73		81			
		125	.57	74	73	72	72	72	72	72	72	70	71	73	73		80			
		250	53	68	66	65	65	66	66	66	65	65	65	65	64		76			
		500	46	61	61	59	59	60	61	61	60	60	60	61	60		74			
		1000	<44	63	62	59	60	59	63	62	63	60	58	60	62		72			
		2000	<44	68	68	65	66	66	68	66	70	64	63	65	68		77			
		4000	<44	66	66	67	63	65	64	64	65	64	60	64	67		78			
		8000	<44	70	66	63	60	63	64	64	63	62	59	63	66		80			
*	AMB	OA		72	72	70	68	69	67	67	67	66	67	67	69		69			
		OA	65	79	78	78	78	78	79	78	78	76	76	78	78		87			
*	AMB	db(A)		59	59	56	55	54	53	52	54	53	54	56	57		55			
		db(A)	49	73	73	71	71	71	73	71	73	71	68	71	73		84			

REMARKS

SURFACE - ASPHALT

* LOAD BANK FAN ON

Sheet ____ of ____

SADI 2125

MFGR RADIAL ENGINE DIVISION

OFFICIAL TEST RECORD

SOLAR TURBINES INTERNATIONAL
An Operating Group of International Harvester

MODEL 10 KW GTED

SERIAL NO.

RATING

CONTRACT NO. DAAK 70-77-C-0032

AUDIO NOISE
"F" KIT - 7 METER
NO LOAD

TEST NO.

DATE 1-15-82

TESTED BY BUTZKE / PHAM

INSP.

INST #																				AVG AMB TEMP
READ NO.	TIME	FREQ	AMB	1	2	3	4	5	6	7	8	9	10	11	12		OP			
UNITS		Hz	db	db	db	db	db	db	db	db	db	db	db	db	db		db			°F
FACTOR																				
		63	60	73	70	71	72	72	73	71	72	69	69	69	70		79			
		125	61	71	70	69	68	68	68	68	66	67	68	68	69		75			
		250	56	66	65	64	63	62	63	62	61	60	62	63	64		73			
		500	48	61	57	57	57	57	57	56	57	57	57	57	58		71			
		1000	<44	62	59	61	61	59	62	60	62	61	60	58	60		72			
		2000	<44	69	65	69	67	64	70	65	69	69	68	62	64		77			
		4000	<44	61	61	61	58	58	59	61	59	59	58	60	63		75			
		8000	<44	67	63	60	57	59	60	61	60	57	57	61	63		77			
		OA	67																	
				78	76	75	75	75	77	74	75	74	74	73	75		85			
		db(A)	52																	
				73	70	71	70	68	73	68	71	71	70	67	69		82			

REMARKS

Sheet ____ of ____

SADI 2125

OFFICIAL TEST RECORD

SOLAR TURBINES INTERNATIONAL
An Operating Group of International Harvester

MFGR RADIAL ENGINE DIVISION
MODEL 10 KW GTED
SERIAL NO.
RATING

CONTRACT NO. DAAK 70-77-C-0032

AUDIO NOISE
"F" KIT - 7 METER
10 KW LOAD

TEST NO.
DATE 1-15-82
TESTED BY BUTZKE / PHAM
INSP.

INST #																					AVG AMB TEMP
READ NO.	TIME	FREQ	AMB	1	2	3	4	5	6	7	8	9	10	11	12		OP				
UNITS		Hz	db	db	db	db	db	db	db	db	db	db	db	db	db		db				°F
FACTOR																					
		63	57	72	70	70	72	74	76	74	75	73	73	72	74		81				
		125	58	73	72	71	70	70	71	70	69	69	70	71	71		80				
		250	54	67	67	65	64	63	64	64	64	63	63	65	66		76				
		500	47	62	58	57	57	57	58	58	58	59	58	59	59		75				
		1000	<44	61	62	59	56	58	63	62	62	59	58	58	61		72				
		2000	<44	65	68	65	60	64	66	64	67	65	63	63	66		77				
		4000	<44	63	65	66	62	66	62	62	64	64	60	66	65		77				
		8000	<44	68	65	61	58	62	61	61	61	59	57	62	64		79				
	AMB	OA		72			68			67			67				68				
		OA	64	78	77	76	76	77	78	77	77	76	76	76	77		87				
	AMB	db(A)		61			54			53			54				55				
		db(A)	50	73	72	71	66	71	71	70	71	71	67	70	71		84				

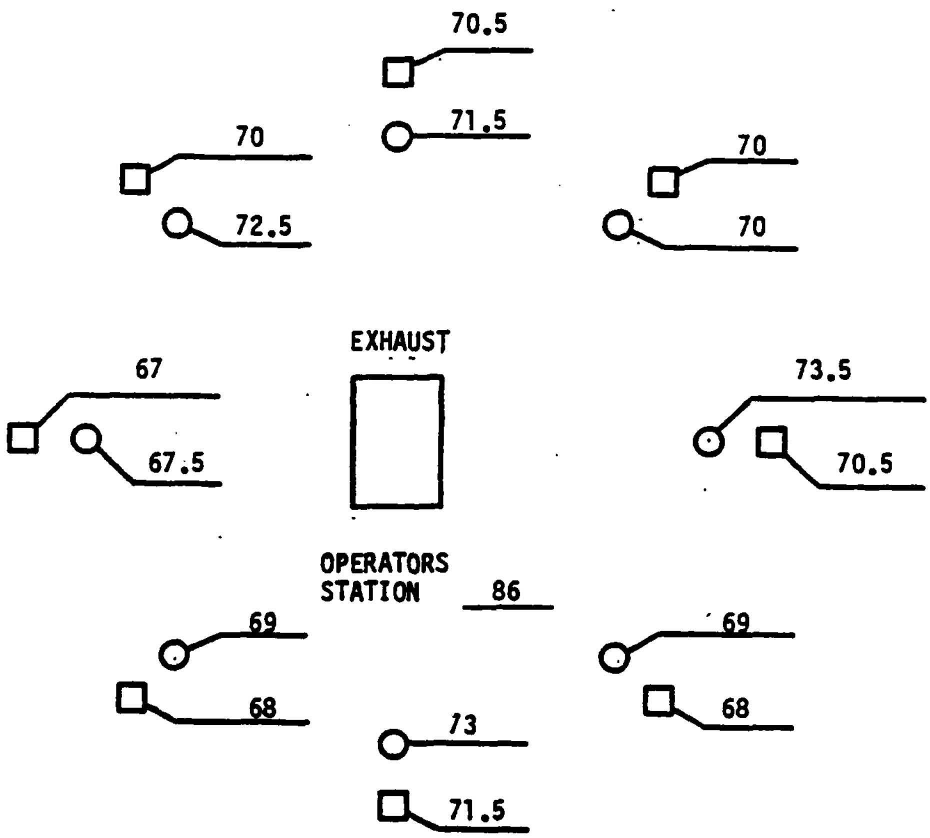
REMARKS

Sheet ____ of ____

SADI 2125

APPENDIX II

PRELIMINARY NOISE LEVEL TEST
10 KW, 60 Hz. GTED GENERATOR SET
PREPRODUCTION "F" KIT ACOUSTIC HOUSING



All Readings dB (A)

○ - 6 Meters

□ - 7 Meters

Ambient - 50 + dB (A)
Surface - Asphalt

ATE

LMED

8